SCIENTIFIC AMERICAN

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THE CASTING OF A LARGE STEAM CYLINDER.

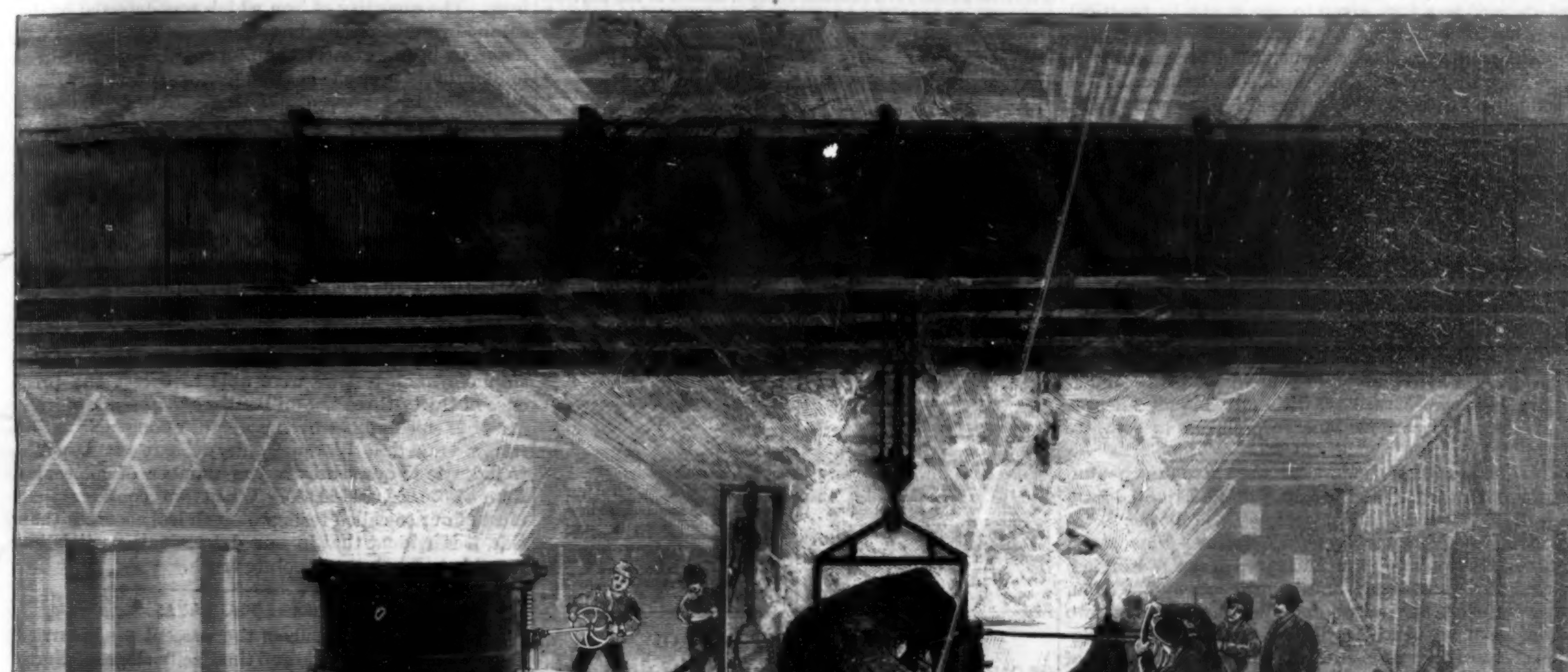
We illustrate in the present issue the operation of casting a very large steam cylinder—one of the largest ever made in this country. The operation was brought to a successful conclusion at the works of the Wheeler Condenser and Engineering Works, at Carteret, New Jersey, on January 26, 1893, a faultless casting resulting.

The mould was built of brick faced with a thin coating of loam, and the core and mould face were both shaped by sweeping. It was strengthened on the outside by iron plates, and the structure was carried up some feet above the foundry floor, as shown in the cut. The interior of the mould communicated by numerous down-takes with an annular trough near the top of the structure. Three large gates, each about 18 inches wide, communicated with the annular trough. The mould was liberally provided with air vents.

The iron used was a mixture of 1x lake and 1x charcoal pig iron and of A1 railroad scrap iron. A charge of twenty-six tons was melted in a cupola, and the melted iron was then distributed between three ladles, one standing ladle of fourteen tons capacity, one swinging ladle of ten tons capacity, and another swinging ladle of eight tons capacity. In preparing the charge the standing ladle was first filled and a period of two hours elapsed between its filling and tapping; in the other ladles the iron stood for a less period. The annular trough and connections were relied on to mix the three irons thoroughly before they entered the mould. The swinging ladles were manipulated by two Sellers overhead-traveling cranes, each of twenty tons capacity. The operation of pouring consumed less than one minute. Owing to the good venting of the mould, the melted iron ran in perfectly quietly. It is also noteworthy that all the preparations for the casting were complete half an hour before the stipulated time.

The weight of the cylinder in the rough was 48,000 pounds; its metal being some 2½ inches thick. After chipping and cleaning, which included removing of the heads, it weighed 45,720 pounds. It was cast so nearly the true size as to leave about ¼ of an inch skin to be removed in the boring. Its internal diameter is 95 inches and it is about 14 feet high, being calculated for an 11 foot stroke.

After remaining in the mould three days, it was re-



THE CASTING OF A LARGE STEAM CYLINDER.

moved still warm, and after cleaning up and chipping was shipped by rail from Carteret to Communipaw, N. J. Here the car containing it was run upon a railroad deck scow and was towed to the works of W. & A. Fletcher, Hoboken, N. J., the builders of the engine. The car in which it was shipped was especially cut out to receive it, but so large was the cylinder that it had but one inch clearance under some of the bridges.

Another cylinder, the mate of this one, has still to be cast. The cylinders are to go into a four-cylindered engine for a new Sound steamer for the Old Colony Steamboat Company. The engine is to be a double compound inclined engine, of 8,000 indicated horse power. Two cylinders such as the one described are for low pressure, and there are to be also two high pressure cylinders of 51 inches diameter, all of 11 foot stroke. The steamer is to have a length over all of 440 feet 6 inches and a width over the guards of 92 feet. She will displace at 12 feet draught 4,550 tons, and will be the largest steamer of her type in the world. The hull is being built at the yard of the Delaware River Iron Ship Building and Engine Company, Chester, Pa. It is to be launched about July 1, 1893. The boat is to be in service in 1894. The paddlewheels will be feathering, a type with which the Fletcher Company have become to some extent identified. As to some extent a prototype of this engine, the engine of the steamboat Plymouth may be referred to. (See SCIENTIFIC AMERICAN, October 4, 1890.)

Gelatine Dry Plate Photography.

The gelatine dry photo. plate process now so commonly used was first given to the world in practical form by John Burgess, of England. Various experiments by different photographers had been made previously with gelatine, but no one had succeeded in producing a definite and successful process until Mr. Burgess showed the way. The first announcement of the Burgess process, in this country, was given in the SCIENTIFIC AMERICAN of August 23, 1873, and reads as follows:

"New Photo Process.—A recent improvement, announced by Mr. Burgess, a photographic artist of Peckham, England, consists in sensitizing gelatine by means of bromide of silver. The mixture is applied warm to the glass plate, and the picture may be taken with the plate either wet or dry. The time of exposure is the same as for the ordinary wet collodion plates. The alkaline pyro. developer is used, the picture making its appearance rapidly, with any required degree of intensity. The new process promises to compete sharply with the ordinary collodion process."

Further details of the process were given in the SCIENTIFIC AMERICAN of December 13, 1873, quoted from the *British Journal of Photography*, as follows:

"*Dry Plate Photography with Gelatine.*—Place seven grains of Nelson's gelatine and seven grains of isinglass in cold water for several hours until soft and swollen, then drain off the water, and put them into a two ounce bottle, which place in hot water until the gelatine and isinglass are dissolved. Add thirteen grains of bromide of potassium, dissolved in a drachm of distilled water, and in another drachm of distilled water dissolve fourteen grains of nitrate of silver, and add it by degrees, in the dark, shaking well between each addition. Now add half a drachm of saturated solution of nitrate of baryta and two drops of muriatic acid. There will be a froth on the top of this emulsion from the shaking, and in order to get rid of this it may be strained through muslin, or if left in the hot water, it will gradually subside.

"This will form sufficient emulsion, at a cost of about two pence, to coat over one dozen quarter plates, which, as coated, should be laid on a flat surface until the film sets, which will take about five or ten minutes, when they can be put away in a box to dry. The drying will take about forty-eight hours (unless they are placed in a current of dry air), or they may be exposed at once. An exposure of thirty seconds, with alkaline developer, should give a negative of sufficient printing density without any intensifying. The plates should be placed in cold water for about a minute previous to developing.

"Emulsions prepared with the silver in excess caused the plates almost surely to fog, and the image to be very thin and faint."

An Omnibus with Pneumatic Tires.

The latest adaptation of pneumatic tires is to the wheels of an omnibus which is being tried by the Glasgow Tramway Company at Glasgow, Scotland. The tires are about 3¼ inches diameter, and can withstand a pressure of 187 pounds to the square inch. To guard against any risk of the India rubber being punctured by sharp stones or otherwise, the tires are thoroughly protected by several plies of canvas, with a covering of wire-wove netting. The omnibus is said to be a very comfortable vehicle to ride in. The inside seats are mounted on springs, which adds to the comfort. There is an electric lamp fixed in the roof, supplied by a box underneath one of the seats containing a sufficient storage of electricity for 24 hours. Twelve passengers can be carried inside and 14 outside.

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NEW YORK, SATURDAY, MARCH 11, 1893.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 897.

For the Week Ending March 11, 1893.

Price 10 cents. For sale by all newsdealers.

DELICACY OF A CERTAIN CHEMICAL TEST.

One of the most delicate tests known to chemical science is that in which potassium sulpho-cyanide is employed to discover the presence or absence of the element iron in a given solution. Potassium ferrocyanide is, perhaps, used more frequently, but gives much less satisfactory results. In cases where this salt failed to indicate the slightest trace, the sulpho-cyanide yielded a very evident proof of the presence of the element in question. The observance of this fact led to an attempt to ascertain as nearly as possible the actual value of the sulpho-cyanide as an iron test. The method adopted was very simple. A small quantity of polished iron wire was weighed out very accurately. In the actual process, 0·0347 gramme was taken. By considering the density of iron, it was found that this weight occupied a volume equal to 0·004458 cubic centimeter. This quantity of iron was now dissolved in hydrochloric acid and water and oxidized, forming ferric chloride, which was then diluted with a sufficient volume of water to yield a solution of one hundred cubic centimeters volume.

This was placed in a burette graduated to one-tenth centimeter, and three-tenths of a centimeter were drawn off, to which the potassium sulpho-cyanide test was applied, which imparted a reddish brown color to the liquid, indicating the presence of iron. The solution was then made more dilute and a second portion was tested. This process was continued until only a very faint tinge of red could be detected. A small quantity of water was again added and the test applied, which, however, did not indicate the presence of iron. The quantity of iron which was detected by the sulpho-cyanide on its last successful application was found to be no greater than forty-three one-hundred-millionths of a cubic centimeter, or thirty-three ten-millionths of a gramme. This seems, indeed, to be a wonderfully delicate test, but it is only necessary to call to mind the approximately determined weight of the molecule of iron to be struck with the crudeness and inaccuracy of our most delicate methods of qualitative analysis.

The weight of a molecule of hydrogen, as given by an eminent authority, is approximately 0·000,000,000,000,000,000,000,04 of a gramme; by multiplying this inconceivably small number by fifty-five, the atomic weight of iron, we ascertain the weight of a molecule of iron—0·000,000,000,000,000,000,000,002,2 gramme. In the sulpho-cyanide test we were able to detect the presence of thirty-three ten-millionths of a gramme of iron; dividing this number by the weight of one molecule of iron, we find that this apparently delicate test is unable to indicate to our senses a less number of molecules than 1,500,000,000,000,000. When we consider that most of our so-called tests are much less accurate than this, it is evident that in our determinations it is impossible to reach the absolute truth.

THE NICARAGUA CANAL.

In view of the demands of the present trade carried on between the Atlantic and the Pacific slopes of North and South America, and of the flattering promises of a greatly increased traffic by the construction of a canal across Central America, the promoters of the Nicaragua Canal scheme ask the United States government to guarantee their securities, and thus father the enterprise and hasten the work of construction by giving the securities financial standing. Both the great political parties of the country have committed themselves in favor of encouraging the building of the canal. Yet, as much as the demands of commerce need the completion of an isthmian passage, it is a question whether the government should commit itself in favor of or against the guarantee asked for until more definite knowledge of the perfect feasibility of the engineering features of the scheme is to be had. The Panama experience is a lesson from which much can be learned, and no patriot American would want it duplicated in any American scheme in such hairbrained engineering plans.

There is little doubt but what the Nicaragua Canal can be constructed on the plans already conceived. But there are greater demands on engineering skill to so construct the canal that it can be maintained. The plans call for many dams of remarkable length and unusual height. There are to be several deep cuts. Then a considerable watershed is crossed at an angle. The climate of Nicaragua is tropical and the precipitation at times is enormous, in fact, far greater than the engineers of the Panama Canal seem to have dreamed of. Another feature of much consequence is the geological formation of the country, which needs most thorough study in such engineering work as deep, narrow cuts and the construction of long, high dams. Several appropriations have been made by Congress and been spent in making surveys of the several proposed routes across the Isthmus, but some of these questions—vital to the successful construction and maintenance of the canal—have not been answered fully to the satisfaction of some eminent engineers who are favorable to the canal scheme.

The experience of the government in building the Sault Ste. Marie Canal has shown that thought should

be had not alone for present needs, but for the future, by recognizing the tendencies in ship building, and that a ship canal should have ample width as well as ample depth. Experience proved that the Suez Canal did not possess enough width as originally constructed, and it had to be widened. Yet, in spite of these costly precedents, the Nicaragua Canal, as at present planned, is surprisingly narrow in places.

However much the Nicaragua Canal may be needed by commerce, it is only ordinary business requirement that such a guarantee as that of $100,000,000 in securities should not be made until there is absolute surety of the successful consummation of the project. New York and San Francisco are now 15,600 miles apart by the water route around Cape Horn. By the Nicaragua route this mileage is reduced about 10,000 miles. From an economic standpoint the construction of the canal would be beneficial, as it would more nearly equalize prices of commodities. The Pacific coast needs the cheap coal of the South and the cheap manufactured products of the North, while the South and the North can take in exchange wheat, fruit, lumber, and other products. But rather than make a hasty effort to secure these benefits, the government can afford to wait a year or two if necessary until a competent commission has looked thoroughly into the weak spots of the canal scheme. It is safe to be thorough in all preliminaries, so that when the work is undertaken and completed it shall be an engineering, a commercial, and a financial success.

THE COMING NAVAL REVIEW.

As the time approaches for the assembling of the great fleet which, at Hampton Roads and in New York harbor, will take part in a magnificent pageant to mark the opening of the World's Columbian Exposition at Chicago, a strong public interest is being manifested in the affair. This will be the first occasion on which the ships of our new navy will come into comparison with those of the leading foreign powers.

The letter of invitation to foreign powers, inviting participation in the naval review, set forth that our government would "assemble a fleet at the prescribed rendezvous at Hampton Roads in the month of April next, with instructions to proceed thence to New York harbor, there to take part in a naval review in connection with the International Exposition at Chicago, commemorative of the 400th anniversary of the discovery of America by Columbus. It is the sincere and earnest wish of the President that this proposed celebration shall be commensurate with the importance of the historical event which it commemorates, and shall illustrate the extraordinary advance in the progress of naval architecture at the present time. To this end the fleet of vessels of the United States will be composed of vessels of the most modern types which shall have been completed at the date named, and the demonstration will further include reproductions of the caravels which composed the fleet of Columbus upon his voyage of discovery."

Twenty-one vessels have been selected by the Navy Department to take part in the review as follows: The New York (flagship), Baltimore, San Francisco, Charleston, Newark, Philadelphia, Chicago, Miantonomoh, Kearsarge, Detroit, Montgomery, Atlanta, Yorktown, Concord, Bennington, Castine, Essex, Dolphin, Bancroft, Vesuvius, and Cushing. Of the foreign powers invited, Austria, Turkey, and Greece have declined, having no vessels available. Germany will send two armored cruisers, the Kaiserin Augusta and the Seeadler. Russia will send a large fleet, and will probably have the largest representation of any nation in the ceremonies. The Russian fleet will include the first-class armored cruisers Dimitri Donskoi and General Admiral, and the corvette Rynda, with Vice Admiral Koznakoff commanding. Great Britain has accepted the invitation, but the fleet has not been definitely selected. The flagship Blake and several vessels of the North Atlantic squadron will be present, and it is probable that one or two belted cruisers will also be sent over. Italy will send the cruisers Etna, Bausan, and Dogali, and perhaps the transport Fridano, under Rear Admiral Magnaghi. Spain will be represented by the cruisers Reina Regente and Infanta Isabel and the gun boat España. The Duke of Veragua and his suite will sail for America on the American line steamer New York on April 8. France has virtually accepted the invitation to participate, but no vessels have yet been designated. Brazil will send the ironclad Aquidaban and the cruisers Republica and Tiradentes. From the Netherlands will come one frigate of the first class, the Van Speyk, and there will be still other participants not yet announced, but enough to constitute the largest naval demonstration ever seen on this side of the Atlantic.

It is the present intention to have the fleet assemble at Hampton Roads on April 26, and proceed thence to the review in New York harbor, but the full details have not yet been settled. Admiral Gherardi, who has been assigned to the chief command, expects that the battle ships in line will stretch from the Narrows up along the North River shore, and has suggested that "instead of having the vessels pass in review, it may seem best that the vessel upon which will be the President, members of the Cabinet, and such other dignitaries as may be with him, should steam down along the whole line and receive the honors that will be due to him."

On the day of the review New York harbor will be under Federal jurisdiction, and there can be no room for doubt but that the great pageant here will be in every way worthy of the great exposition whose inauguration it will mark.

The American Silk Industry.

According to Census Bulletin No. 348, the advance in the state of this art for the past decade has been wonderful, not only in the quantity and character of production, but in the invention and development of improved machinery, through the operation of which silk fabrics of all descriptions have been brought within the reach of the masses and, to considerable extent, translated from the category of luxuries to that of necessities. The success attending the industry of silk manufacture in the United States has naturally given birth to healthy home competition, with the result that production has been stimulated and American-made silk goods now find abundant demand within our own markets.

The classification of silk goods of American manufacture is now practically without limit, embracing every article made in the older silk-manufacturing countries, and fully equal to the foreign product in quality of weave, beauty of design, and excellence of finish.

The value of the net or finished production of silk goods manufactured during the census year 1890 was $69,154,599, against $34,519,723 for the census year 1880, an increase of $34,634,876, or 100·33 per cent.

The following is a comparative statement:

	1890.	1880.
Number of establishments.........	472	382
Capital invested.....................	$51,007,537	$19,125,300
Number of hands employed.......	50,913	31,337
Amount of wages paid.............	$19,680,318	$9,146,705
Miscellaneous expenses...........	$4,345,032	....
Cost of materials used.............	$50,919,016	$22,467,701
Value of product.....................	$87,298,454	$41,033,045
Number of spindles.................	1,254,798	508,137
Number of looms.....................	22,569	8,474

These figures do not include the operations of fifty-two establishments engaged in dyeing and finishing silk goods, with an invested capital of $2,368,157, employing 1,745 hands and paying $1,013,325 in wages.

This report was prepared under the general directions of the division of manufactures of the Census Office by Mr. Byron Rose, special agent, assisted by Mr. Peter T. Wood.

LOCATION OF SILK MILLS.

The following list, substantially complete, indicates the location of silk mills, with the year of their establishment, at points where none existed prior to 1880. At a number of the locations named additional mills have also been erected within the last census decade, but only the first one established is referred to in this list.

1880. Poughkeepsie, N. Y.
Boonton, N. J.
Hawley, Pa.

1881. Dover, N. J.
Linden, N. J.
Allentown, Pa.
Darby, Pa.

1882. Bridgeport, Conn.
Preston, Conn.
Tariffville, Conn.
Oswego, N. Y.

1883. Athol, Mass.
Auburn, N. Y.
Easton, Pa.

1884. Woonsocket, R. I.
Marlboro, Conn.

1885. Stirling, N. J.
South Bethlehem, Pa.

1886. Becket, Mass.
Newton Upper Falls, Mass.
Guilford, Conn.
Fultonville, N. Y.
Phillipsburg, N. J.
Bethlehem, Pa.
Catasauqua, Pa.
East Mauch Chunk, Pa.
Harrisburg, Pa.
Stroudsburg, Pa.
Wilkesbarre, Pa.

1887. Hopedale, Mass.
Mapleville, R. I.
Glenn, N. Y.
Middletown, N. Y.
Norwich, N. Y.
Whitehall, N. Y.
Hackettstown, N. J.
Honesdale, Pa.
Hagerstown, Md.
Pittston, Pa.
Reading, Pa.
Belding, Mich.

1888. Jamestown, N. Y.
Bayonne, N. J.
Midland Park, N. J.
Port Oram, N. J.
Altoona, Pa.
Bloomsburg, Pa.
Pottsville, Pa.
Tobyhanna, Pa.
Weatherly, Pa.
Petersburg, Va.
Wadesboro, N. C.

1889. Argusville, N. Y.
Hillburn, N. Y.
Hornellsville, N. Y.
Kinderhook, N. Y.
Matteawan, N. Y.
Spring Valley, N. Y.
Steinway, Long Island, N. Y.
Oakland, N. J.
Pompton, N. J.

1890. Sandwich, Mass.
Monroe, N. Y.

Preserve for Binding.

The publishers of the SCIENTIFIC AMERICAN would advise all subscribers to preserve their numbers for binding. One year's issue (52 numbers) contains over 800 pages of illustrations and reading matter. The practical receipts and information contained in the Notes and Queries columns alone make the numbers worth preserving. Persons whose subscriptions have commenced since the beginning of this year can have the back numbers sent them on signifying such wish. Their subscriptions will then expire with the year.

Eight Young Naturalists.

The daily *Sun*, relating how eight New Jersey boys, with a taste for natural history and some training in that line, made a very profitable and enjoyable use of a part of their vacation last summer, adds:

These boys, who were high school students, took a walking and collecting trip. In twelve days they traveled 160 miles, and came home with a new stock of health and a big load of collections. It was a very cheap trip, too, the total expenses being $9 for each member of the party.

The expedition left Montclair one morning about the middle of June. One of the boys supplied a strong horse, which was attached to a grocer's delivery wagon. A vehicle was needed for their camp equipment and their collections. They had a complete camping outfit except a tent, which they had not been able to borrow; so they made up their minds that they would give the farmers a chance to offer them the hospitality of their barns. The idea worked well, and every night they slept on the hay in one or another of the capacious barns of New Jersey. Their wagon carried food supplies for two weeks.

Each boy had a valise and a roll of blankets. Then there were botany cans, a collecting press and driers, geological hammers, a camera, and all the other apparatus the boys needed for such a tour. Before they left home they agreed upon their daily routine. They were to have cooked meals morning and night and a cold snack at noon. Four boys each day attended to the culinary department, two serving as cooks and the other two serving the meals. The next day the other half of the party took their turn at the cooking pot. Usually the commissary detail rode in the wagon while the others were busy with beetles, bugs, plants, and minerals.

The boys studied every geological formation from Newark to the Delaware Water Gap. Some of the most interesting places visited were the slate quarries at Newton, the mines at Sterling Hill and Franklin, which are so rich in the beautiful crimson and green ores of zinc, and the Delaware Water Gap, where the young students were greatly interested in the finely exposed rock formations. Many specimens of everything that interested them were obtained, and when they came home they enriched the cabinet of the high school and had many things left to label and store away in their private collections as souvenirs of a very sensible and pleasant vacation jaunt.

The example of the eight Montclair boys may well be emulated by students in many places who have a fondness for nature and a taste for collecting specimens.

How Fires Affect People.

In a fire you get very close down to human nature, observes the New York *Sun*. The other night an apartment house took fire. There was no time to be lost by the inmates. A mother, scantily clad and crying, took out her two little children. A wife buttoned herself in her long newmarket and ran, leading her brown-eared setter. A devoted son and daughter on the top floor dressed warmly their helpless old mother of 80 and waited to carry her, if need be, across the fire escape. One woman put on a furlined cape over her night dress and came forth with a traveling bag filled with silver. A young widow ran for her new Sunday frock and took down the departed one's portrait. Another came forth fully equipped as for church, in jacket, tipped hat, and crimps. Another young woman left all her belongings and fled in her night dress, blistering her bare feet on the cinders, and ran down the street calling for a carriage. Another got her valuables in her sealskin coat, and finding the smoke not too threatening, fished out her long-tailed gown and the black silk silhouettes of her grandfather and grandmother, which she knew she couldn't replace. One man contented himself with a bath robe, another dressed himself in his four-in-hand tie and scarf pin.

Hygiene and Sanitation at the Exposition.

The Bureau of Hygiene and Sanitation at the World's Columbian Exposition has been organized for the purpose of giving as complete a view of the present state of the science as possible. More and more attention is being given to sanitary science, and the truth of the expression "the common health is the common wealth" is being abundantly proved by the decreasing death rate in many of our leading cities. The exhibit bids fair to be of interest not only to the specialist, but to the general public also. Athletic training both at home and at the gymnasium will be well represented. Food, its preparation and sophistication, will occupy a large amount of floor space. Another class (827) will include dwellings, their sanitary defects and the best means of remedying them. This will be followed by hotels, public baths, lavatories, models relating to the disposal of the dead, the supply of water, the disposal of sewage, etc. Such subjects as dust nuisances, the removal of noxious vapors, the danger from infectious diseases in certain trades, will be given great attention and will doubtless be productive of much good.

MODERN SUNDIALS.

In some former articles we endeavored to show how much ingenuity and artistic feeling were displayed in the construction of sundials before the telegraphic transmission of time and the advent of the cheap watch. We did not then believe that the sundial was still in current use, and our object was particularly

Fig. 2.—OLIVER'S MEAN TIME SUNDIAL.

Fig. 3.—FLECHET'S UNIVERSAL SUNDIAL.

to insist upon the utility of its study as regards the teaching of cosmography. Since then, new documents have reached us, furnished in part by the readers of *La Nature*. We have thus learned, not without some surprise, that the sundial is still frequently employed. Under a complex form, it may be adapted to various uses, while of very simple construction, but of large dimensions, it permits of attaining sufficient precision for the regulation of watches of medium accuracy. Finally, in certain of these instruments, a special arrangement permits of directly reading the mean time. Such, for example, is the case with the dial devised by

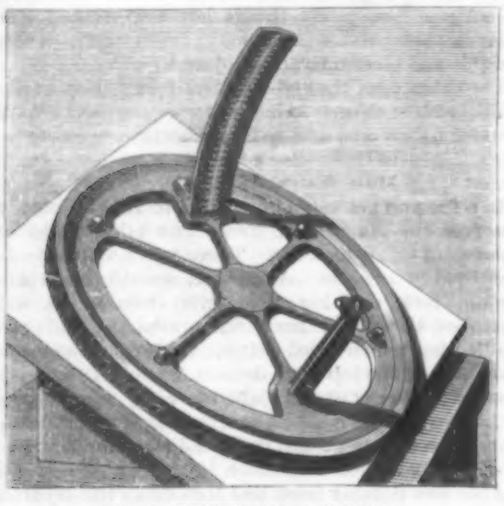


Fig. 1.—THEVENOT'S SUNDIAL.

Major General Oliver (Fig. 2). The time is read upon an equatorial circle, A, while the shadow is projected, not by a simple rod, but by an enlargement, B, of the style, the section of which is given by the well known curve of the equation of the time. According to the season, the time will be read to the right or left of the shadow. The circle, C, carries a division in degrees that permits of regulating the instrument for all the boreal or austral latitudes.

Fig. 1 represents a dial constructed by Mr. C. Thevenot. It consists of a sort of bronze wheel 767 millimeters in diameter carried by an axle that revolves in an aperture formed in a marble table upon which the wheel is exactly applied. This table is inclined toward the horizon by an angle equal to the complement of the latitude of the place, the line of the greatest slope being oriented from north to south. In this way, the axle of the wheel is parallel with the axis of the world. A lens of about 50 centimeters focus projects the image of the sun upon a piece curved into an arc of a circle and carried upon the wheel at a point diametrically opposite. The observation consists in bringing the image upon the median line of the arc of a circle. The time is then read upon the circumference of the wheel opposite an index sealed in the marble. The dimensions of the apparatus constructed by Mr. Thevenot are such that a minute of time corresponds to a length of 1·6 millimeters at the circumference. It seems that it is possible without difficulty to determine the true time within a few seconds. The mean time is deduced therefrom by adding to it the equation of the time given in a table.

The dial (Fig. 3) constructed by Flechet, as long as thirty years ago, is much more complex. It is designed for observations in traveling, and can be arranged, under a small bulk, in a box that serves as a support for it when it is desired to effect a measurement. It consists, like several of the instruments previously described: (1) of a meridian circle, M, cut away on the side toward the sun so as not to interfere with the observation; (2) of an equator, E; and (3) of a horary circle, H, movable around the axis, A B. The circle, H, is provided with a small hole corresponding to a circular hollow of the circle, E. It is through this that pass the solar rays that form a luminous point upon a screen carried by the circle, H, and upon which has been traced the curve of the mean time, accompanied with dates of four to four days for the entire year. The instrument revolves around an axis, C, placed vertically by means of the level that the instrument carries. Let us suppose that we have regulated the instrument according to the latitude of the place by means of the division of the circle, M. It will remain for us to put the latter in the meridian. To this effect, we direct the horary circle toward the sun, so as to form the image upon the curve of the mean time. We know that this curve must be described in one year by the image of the sun, which must recede from or approach the equator of the instrument at the same time that the sun itself recedes from or approaches the terrestrial equator. Turning, then, simultaneously, the dial around the axis, C, and the circle H, around A B, we make the luminous point describe a part of the curve, and we fix the instrument when such point marks the date of the day of the observation At this moment we are sure that the circle, M, is in the meridian and that the circle, H, indicates the actual time upon the equator. Up to here the instrument does not differ essentially from a very old sundial that we have already described. But the curve of the mean time will permit us to determine even the latitude of the place, if we do not know it. It will suffice for this to observe the passage of the sun at noon. To this effect, let us place the horary circle upon the midday of the instrument, and let us give the axis, A B, an inclination such that the image of the sun shall form upon the curve of the mean time at the place corresponding to the date of the day of observation. If the operation has been begun before noon, we shall see the image descend upon the curve. It will be carried back constantly by lowering the axis, A B. The motion will gradually become slower, and will soon cease entirely. The axis, A B, will then be parallel with the axis of the world, and it will suffice to read the position of the circle, M, in order to know the latitude. Starting from this moment, the instrument will be able to serve for determining the hour.

Of all the sundials constructed up to the present, the latter is doubtless the completest, and the one that is best adapted for all the approximate determinations that one may have to make on a voyage. In this respect it is worthy of having the attention of explorers called to it.—*La Nature.*

HICKORY WOOD CARVED BY WORMS.

We recently received from a valued correspondent a strip of hickory wood, the surface of which is ornamentally carved or grooved as represented in our engraving. Our correspondent writes as follows:

"I send you a piece of hickory wood beautifully carved by the worms, which perhaps will be of some interest.

"Some days ago, in cording up storewood, I came across this piece, which is a curiosity to me. It appears that the eggs were deposited in a central groove made by the insect parallel with the grain of the wood, and after being hatched the larvæ began to 'cut' the wood, each one at a certain angle, which is uniform throughout. I account for the gradual widening of each groove by the growth of the worm.

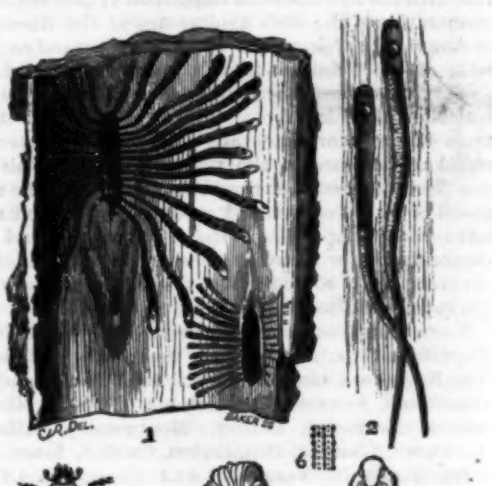
"It will also be noticed that the outside worms turned their course and worked parallel to grain of the wood, but in no case does it seem that any one cut across his brother's pathway. However, when one died, those on each side soon found it out and began to draw closer to each other, until they were at an equal distance apart. All the pieces I examined were the same as the one I send you. There is something beautiful about the 'carving,' at least, and to my mind is worthy of notice and study. Hence I send this piece to you, believing that it would not prove uninteresting to the SCIENTIFIC AMERICAN.

"ARTHUR R. SPAID.

"Wilmington College, Wilmington, Ohio."

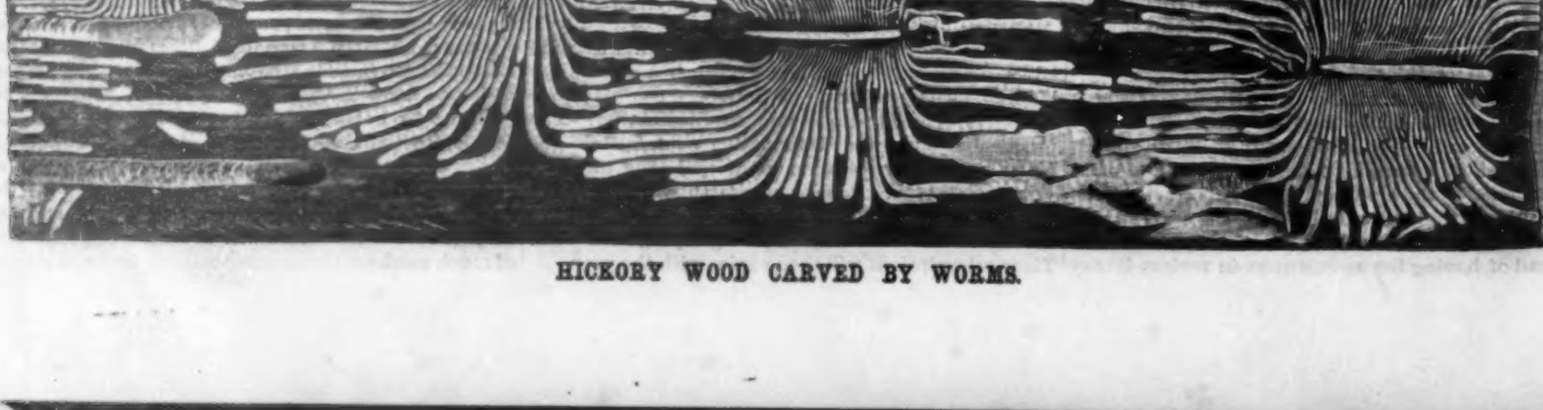
The specimen was so interesting that we submitted it to Dr. C. V. Riley, entomologist, of the Department of Agriculture, who has favored us with the following:

Reply by Professor C. V. Riley.—The specimen sent by Mr. Spaid is a very fine illustration of the workings



THE HICKORY BARK BORER. (*Scolytus 4-spinosus.*)

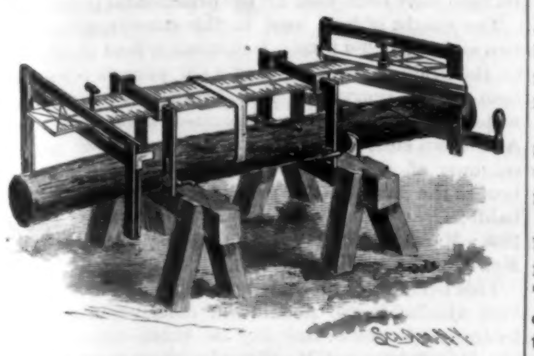
of the hickory bark borer, and his remarks both as to the non-crossing of the burrows and the closing up of the space left by any of the grubs which die are quite correct and are true of almost all of the bark borers belonging to the family Scolytidæ. This particular species was first illustrated and described by me in the *Prairie Farmer* for February 2, 1867, under the name of *Scolytus caryæ*, and a fuller account of it is given in



HICKORY WOOD CARVED BY WORMS.

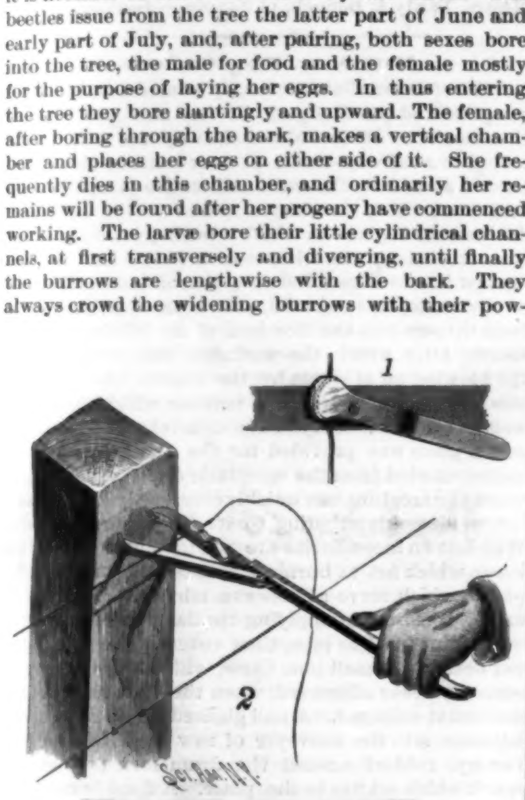
my fifth report on the insects of Missouri, 1871, pp. 103-8. My first acquaintance with it was through Mr. Arthur Bryant, of Princeton, Illinois, a brother of the late William Cullen Bryant. Mr. Bryant had a beautiful hickory grove of trees growing on rich soil bordering on Bureau River. The hickory was the bitter-nut and this borer had sadly thinned out the beautiful grove at the time he sent me specimens.

In connection with the illustration it is hardly necessary to describe the characteristic burrows, which



JOHNSTON & SANDBERG'S SAW GUIDE.

it is needless to state are made by the larvæ. The beetles issue from the tree the latter part of June and early part of July, and, after pairing, both sexes bore into the tree, the male for food and the female mostly for the purpose of laying her eggs. In thus entering the tree they bore slantingly and upward. The female, after boring through the bark, makes a vertical chamber and places her eggs on either side of it. She frequently dies in this chamber, and ordinarily her remains will be found after her progeny have commenced working. The larvæ bore their little cylindrical channels, at first transversely and diverging, until finally the burrows are lengthwise with the bark. They always crowd the widening burrows with their pow-



DURR'S FENCE WIRE STRETCHER.

dery excrement, which is of the same color as the bark. The full-grown larva is soft, yellowish and without trace of legs. It remains torpid in the winter and transforms to the pupa state during the following May. The exit holes from which the newly developed beetles issue are direct from the sapwood and not slanting, as in the case of the entrance holes, and a tree badly infested looks as though it had been peppered with No. 8 shot.

The sexes differ considerably from each other, the males having four spines on the truncated portion of the abdomen not possessed by the female. The eggs are deposited during the months of August and September, and the whole transformations are effected within one year, as no larvæ will be found remaining in the tree during the latter part of July. The description was originally drawn up from the female only, and after the male was discovered it was found to be the *Scolytus 4-spinosus* of Say, the female of which had not been previously known. Hence the proper name of our hickory bark borer is *Scolytus 4-spinosus*.

The larger elliptical or flattened burrows in the piece of wood sent by Mr. Spaid are made by a long-horned beetle (*Saperda discoidæ*, Fab.), a species which is almost invariably found associated with the bark borer in its destructive work.

There are several parasites, as, for instance, *Spathius trifasciatus*, Riley, and *Bracon scolytivorus*, Cress., which prey upon this bark borer, and fortunately keep it in check.

So far as remedies are concerned, the habits of these bark borers rather defy our efforts to prevent their injury, especially on large trees and in large groves. There are two methods of dealing with them: *i. e.*, to cut down and use the trees the moment they are noticed to be attacked, and to encourage the natural enemies which are already helping. The species affects most of the species of the genus Caryæ, including the bitter-nut, shell-bark, pig-nut and pecan.

A SAW GUIDE TO FACILITATE LOG SAWING, ETC.

A device by means of which a saw may be conveniently guided in making straight or angular cuts, at measured distances or otherwise, is shown in the illustration, and has been patented by Messrs. Henry L. Johnston and John E. Sandberg, Butte City, Montana. A top plate having graduations and angle lines is supported in two or more carriers, each having a leg with curved foot resting on top of the log, while the head of each carrier has apertures for the horizontal members of L-shaped arms to be bolted together on top of the plate, and adjustable to fit over logs of different diameters. The vertical members of the arms have slots, in each of which is adjustably held a bolt with handled screw rod to fasten the arms in place on the log to prevent lateral shifting of the plate. That the plate may be conveniently folded, it is made in two parts hinged together, and one leg of an L-shaped arm extends over the hinge joint, the other leg having a point adapted to be driven into the side of the log. In each of the free ends of the plate turns and slides a set screw screwing in the top of a frame on the top of the plate, and in the ends of this frame are vertical guide-ways in which slide the ends of a frame supporting vertical bars held a sufficient distance from the frame to permit a free passage of the saw blade. The frame and its bars straddle the log, and the saw is reciprocated through the space between the depending ends of the frame and the bars, set screws resting on the back of the saw and permitting the frame to descend as the depth of the cut increases. Before commencing to saw, the operator adjusts the frame to the desired graduation on the top of the plate, when the saw in its downward movement follows the position of the frame, so that the angle indicated on top of the plate will correspond with that of the cut made by the saw. The several parts of the device may be readily taken apart and folded up in small compass for carrying.

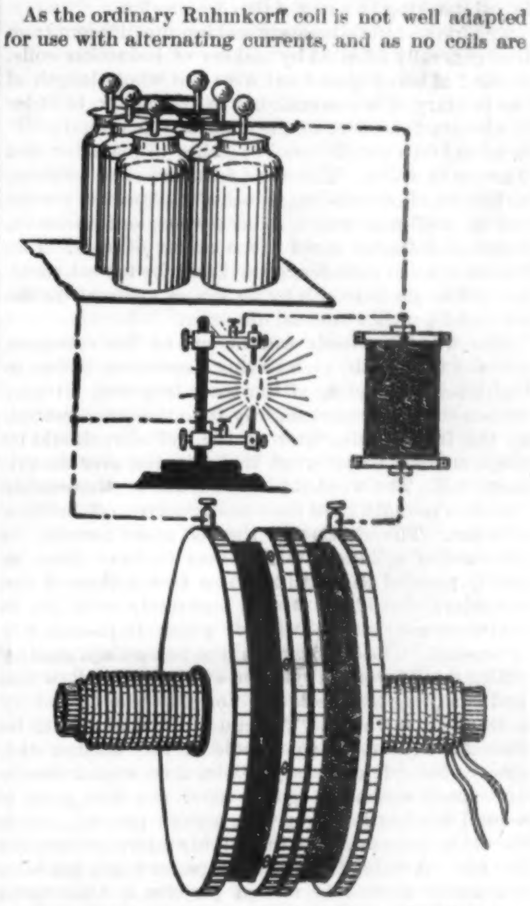
A CHEAP AND SIMPLE FENCE WIRE STRETCHER.

This improved tool for stretching wire strands while applying them to fence posts, holding the wire taut while the operator drives a securing staple in the post, has been patented by Mr. Franklin Durr, of Pittsfield, Ill. The main bar or lever of the implement has toes on its forward side edge, and there is an open recess on its top side, the forward shoulder of the recess being curved toward the end of the lever and slightly rounded. On the recessed part of the lever a locking limb is pivoted, as shown in Fig. 1, the end of such limb being rounded to form a crimping shoulder, and a guard flange projecting over the forward shoulder of the recess in the lever, to prevent a gripped wire from slipping off the shoulder. An offset bend in the handle portion of the locking limb enables the operator to work this piece without injury to his hands. A brace bar is pivoted to a side edge of the lever, to be brought in engagement with a post, as shown in Fig. 2, when the proper strain has been produced upon the strand, the brace bar then holding the wire taut until it is permanently secured, and preventing a recoil movement of the lever. With this tool one man can readily build a long line of barbed wire fencing without assistance in the matter of stretching and securing the wire strands.

AN INDUCTION COIL FOR ALTERNATING CURRENTS.

R. W. WOOD.

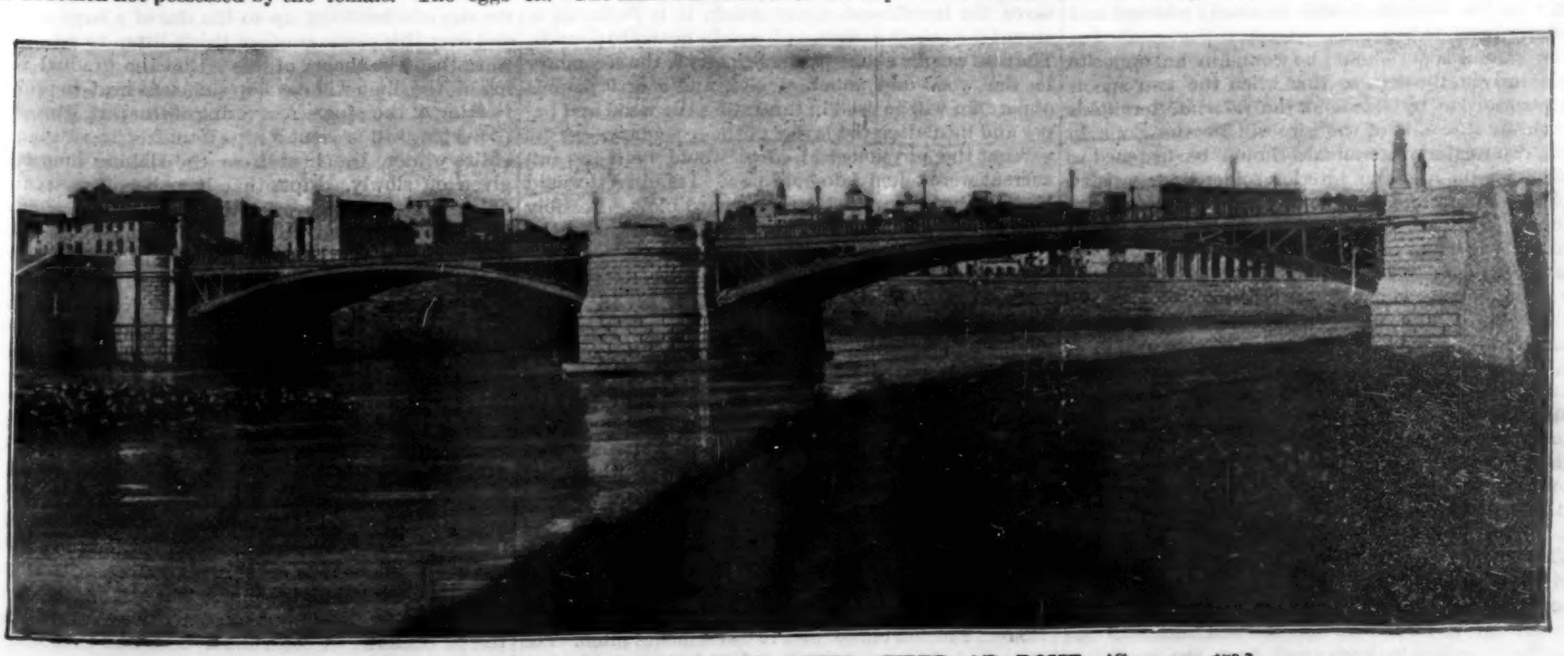
As the ordinary Ruhmkorff coil is not well adapted for use with alternating currents, and as no coils are



INDUCTION COIL FOR ALTERNATING CURRENTS.

on the market capable of being run to advantage by currents supplied for illuminating purposes, I think that the description of a cheap but powerful instrument will be of general interest to the readers of the SCIENTIFIC AMERICAN.

For spectroscopic and other work requiring a powerful discharge, it has been customary to employ a large Ruhmkorff coil in connection with a galvanic battery; but this form of apparatus, owing to the large initial cost and the expense of constantly renewing the cells, is not as suitable or economical as an instrument that can be run by currents, furnished at low cost for light-



THE GARIBALDI BRIDGE OVER THE RIVER TIBER AT ROME.—[See page 150.]

ing purposes. The discharge, too, is far more powerful. My coil, when connected with a condenser of six one-gallon Leyden jars, the primary being fed with a 52-volt alternating current from a Thomson-Houston transformer, produces a discharge the roar of which is so terrific that it is unpleasant to remain for any length of time in its vicinity. The power of the discharge can, however, be decreased to any extent if the nerves of the experimenter require it. Such a coil can be constructed at an outlay of about $30, and can be operated for a few cents an hour.

The core consists of a bundle of soft iron wires 15 inches long by 2 inches in diameter. Great care should be exercised to obtain wire of a suitable quality. Ordinary so-called soft iron wire furnished by hardware dealers is wholly unsuitable. The best material is known as "core wire," and can be obtained from any large dealer in electrical goods. Around this core are wound two layers of No. 6 double-covered magnet wire, the core being first wrapped with one or two thicknesses of thick paper to prevent possible short-circuiting. It is not necessary to paraffin or varnish these layers, as there is but little tendency toward internal sparking in a coil of this description.

The form of the secondary coil is quite different from that generally adopted by makers of induction coils. Instead of being spread out over the whole length of the primary, it is concentrated in the center, in order to obviate the effect of the ends of the primary. It is wound on a double spool 14 inches in diameter and 6 inches in width. This spool is made in two sections, as follows: Four wheels, 14 inches in diameter, are cut out of half-inch well seasoned wood, and a hole 3¼ inches in diameter bored in the center of each. Two hollow wooden cylinders should then be turned, measuring 3 inches in length by 3¼ inches external diameter and 2¾ inches internal diameter.

The wooden wheels will fit on to the cylinders, forming two spools, each having a space two inches in width for the winding of the secondary coil. It may be necessary to depart slightly from these dimensions, as the internal diameter of the cylinders should be large enough to allow of their slipping over the primary coil. The wooden pieces should be thoroughly boiled in paraffin until they cease to give off bubbles of steam. The wheels may then be glued securely to the wooden cylinders, taking care to have them as nearly parallel as possible. The two actions of the secondary should be wound separately with No. 30 cotton-covered magnet wire, of which 15 pounds will be needed. The winding can best be accomplished by fitting a solid wooden cylinder within the hollow one and mounting the whole affair on a spindle turned by a crank or in a lathe. The end of the wire should be passed out through a small hole in the wooden disk close to the cylinder, and the wire then wound evenly and closely across the spool. After the first layer is wound it is brushed over with melted paraffin, which should be hot enough to thoroughly interpenetrate the strands. A strip of thick brown paper which has been previously soaked in melted paraffin is then fitted neatly over the layer and the ends fastened together with hot paraffin. The paper should come close against the sides of the spool and the junction should be painted with paraffin to insure perfect insulation. The next layer is then wound and treated in the same way. It is difficult at first to wind the wire evenly and closely, but with a little practice the wire may be made to guide itself. If the turning is done by hand it is better to have some one to work the crank, and give one's entire attention to guiding the wire. The winding should proceed, each layer being brushed with hot paraffin as described, and insulated from its neighbor by the paraffined paper, until the wire is within three-quarters of an inch of the rim of the spool. If a break occurs in the wire, it should be neatly soldered and carefully insulated.

The second spool should be wound in an opposite direction from the first, so that when the two spools are placed side by side and the *internal* terminals joined, the direction of the wire will be the same in each. The exterior terminals should be fastened to binding posts and the interior soldered or twisted together, and the spools should then be fastened together by driving three-quarter inch brass screws through the rims of the two inside wheels. Care should be taken to have them fitted exactly, so that the primary coil may pass easily through the center of the bobbin. A fine finish may be given to the coil by ebonizing the woodwork and covering each section of the secondary with a strip of thin hard rubber. If there is any spare room between the primary and secondary, it may be filled by covering the primary with black silk or a thin tube of hard rubber. A covering of some sort is necessary to prevent the heavy secondary coil from abrading the insulation of the primary. The coil is now finished. No interrupter, commutator or condenser is required.

The primary wire should be fed with an alternating current of about 52 volts, such as is furnished by the Thomson-Houston incandescent system. As soon as the current is turned on the coil will hum, and care must be exercised to keep away from the secondary terminals. The discharge differs curiously from the ordinary Ruhmkorff. Only a very small static spark can be drawn from a single terminal, by approaching the finger to it, and no discharge takes place between them until they are brought within a quarter of an inch of each other, and it is best shown between two carbon points. As soon as they are brought within striking distance a small arc will be established, and they may then be separated to a distance varying from two to four inches, according to the strength of the current in the primary. The arc emits but little light, and bends upward in a graceful curve with the current of hot air.

It is with the Leyden battery that the tremendous power of the coil can be shown. From six to ten gallon jars, or more of a smaller size, should be connected with the terminals of the coil, as indicated in the diagram; all the inner coatings being connected with one terminal, and the outer with the other.

The discharge now consists of a torrent of thick blue sparks, which gives rise to a most deafening sound that is a combination of a hiss and a roar. The power of this discharge may be still further increased by putting into the circuit a coil of high resistance, as shown in the diagram, such as the secondary of a medium sized Ruhmkorff, which adds to the capacity of the circuit. Great care should be taken not to allow the current to pass through the body, as the effects are very painful, if not dangerous. I have accidentally taken the current from my coil when running at about one-fifth of its full capacity, and do not care to repeat the experience. There was an awful wrench, followed by a sensation as of just awakening from an anæsthetic sleep. I imagine that the current produced complete unconsciousness for a fraction of a second, though I did not fall.

The powerful discharge from the coil used in connection with the Leyden jars is most admirably suited for obtaining metallic spectra, either for photographic or visual purposes. If the metal is easily volatilized, or in the form of a chloride, the arc obtained by using the coil alone will show the spectrum of the metal entirely devoid of the air lines which are always present when the bright spark from the condenser is used. The coil may be also used to advantage for operating large-sized vacuum tubes. A very pretty effect may be produced by allowing the discharge to pass between two carbon points in a low vacuum under the receiver of an air pump. If the points are first brought close together, in order to start the current, they may be separated as far apart as the dimensions of the receiver will allow, and there will be formed a beautiful arc of purple fire, a foot or more in length, surrounded by a wide aureole of a pale yellow-green color, and the receiver itself will shine with a pale blue phosphorescent light.

If the current feeding the primary is furnished by a transformer, the incandescent lights supplied by the transformer will be greatly dimmed while the coil is in action. This is because the primary acts on the transformer as a choking coil, lowering its electromotive force. If this is an inconvenience, as may often be the case, it may be remedied by increasing the self-induction of the primary. This may be done by winding a hundred or two turns of No. 15 double-covered wire into a coil three or four inches in diameter, and slipping it over one end of the primary in such a manner that, when placed in circuit with the primary, the direction of the current will be the same in the two coils. This will decrease the capacity of the coil to a great extent, but the discharge will be as powerful a one as it is comfortable to work with, when the jars are in circuit. It is a good plan to make a strong wooden stand for the coil, which will support the primary on each side of the secondary; and, if it is necessary to move the instrument about much, it is desirable to mount it on chair casters, as it weighs nearly 50 pounds. The core weighs about 10, the primary 9, the secondary 15, the wood and paper about 4, and 8 or 9 pounds of paraffin will be used in saturating the wood and paper and insulating the layers of the secondary.

What the physiological effect would be if the full current were taken I do not know. I doubt if it would be fatal, but it would be a very hard blow. Possibly coils of this description, built on a large scale, would be convenient for electrocutions.

THE GARIBALDI BRIDGE OVER THE RIVER TIBER AT ROME.

This bridge, built in 1888, crosses the Tiber near the historical island called Isola Tiberina, which is said to have been formed by the mass of grain plundered by the population in a revolt against the Tarquins. Tradition has it that the god Esculapius hid himself in this island in the disguise of a serpent which the priests had captured in a Greek temple and brought to Rome in order to avoid a plague. This island was afterward cut to the shape of a vessel, and there was built the temple of Esculapius, of which are still to be seen the remains.

The bridge is formed with two large iron arches of 173 feet 8 inches chord and 16 feet 4 inches pitch. The distance between the parapets is 65 feet 6 inches. Each span is composed of thirteen arched ribs, and the pavement is of stone. The central pier is 39 feet 3 inches wide at the top and 46 feet wide at the base. The abutments and the central pier have been put in place upon foundations sunk by means of compressed air caissons to a depth of 50 feet below low-water level of the river, and rest upon a layer of compact sand. The foundations of the abutments and central pier have required 29,925 cubic yards of masonry, while 2,930 cubic yards of *travertino* and 1,007 cubic yards of granite of Baveno have been used for the ornamental portions.

The weight of iron used in the construction of the two arches is 1,680 tons. A maximum load of 880 tons on the bridge gives a stress of 8,450 pounds per square inch on the ironwork. This bridge cost $720,000, of which $200,000 has been expended upon iron work. At the two ends of the bridge there are four granite columns of the ancient *miliarie* form, bearing in bronze the dates of the principal campaigns of Garibaldi: *i. e.*, Montevideo, 1847; Roma, 1848; Varese, 1859; Marsala, 1860; Volturno, 1860; Bezzecca, 1866; Mentana, 1867; Digione, 1871.

This bridge was designed by Signor Angelo Vescovali, who holds the position of chief engineer of the hydraulic service of the city of Rome—who designed the Margherita and Magliana bridges—and the works have been executed under his supervision by Messrs. Zschokke & Terrier. The iron work was supplied by Messrs. Tardy & Benech, of Savona.—*Industries.*

How Some Fires Originate.

A list of unusual and curiously caused fires has been compiled and the *Railway Review* mentions some of the number. It includes a factory fire which was traced to a railway truck, an over-heated axle having thrown a car from the track and set fire to a petroleum tank from which the flames spread to the building. An instance is given in which a bucket of greasy waste was ignited by the friction of a belt which sagged against it. In a harmless case of spontaneous ignition of oily waste, this material, with some wood chips, had been thrown into the fire box of an idle locomotive, shortly after which the workmen were surprised by the blowing off of steam by the engine. Another fire was due to oily waste in a manner which could not well be foreseen. Only heavy mineral oils were used, and a place was provided for the waste, but a cockchafer crawled from the receptacle directly to a gas jet, when the creature was quickly consumed, and the oily cotton filaments adhering to its body spread the fire. Well known incendiaries are photographic and other lenses which act as burning glasses, and bright tight plates, which serve as concave mirrors. A plumber's exploit consisted in applying the flame test to a newly made joint in a gas pipe, then covering the pipe without noticing a small blue flame, which was discovered some six weeks afterward, when the leak had become somewhat enlarged. A nail glanced from a carpenter's hammer into the conveyer of raw material in a jute factory, rubbed against the drum and produced a spark which set fire to the place. A flood burned one factory by causing a pile of iron filings to oxidize so rapidly as to become intensely heated. A stream from the firemen's hose started a second fire in New York while putting out one in a small building, a neighboring shed containing quicklime having been penetrated by the water.

To Thaw Out Frozen Pipes.

The *Builders' Gazette* recommends as an easy and cheap method of preventing pipes that are on or near the surface of the ground from freezing to cover them first with a thin layer of sawdust, spent tan bark, or any kind of litter. Next a layer of quicklime in lumps the size of a hen's egg up to the size of a large orange, and over this place another thick litter to retain the warmth. The theory of this is that the gradual slaking of the lime will develop sufficient heat to prevent freezing of the pipe. A covering of this sort, if properly protected, will prevent a pipe from freezing during an entire winter, the heat from the slaking lime being given off slowly. Pipes that have been frozen can be quickly thawed by covering them with a layer of quicklime in lumps and slaking it by pouring on water. The object of the layer of litter next to the pipe is to prevent corrosion by contact with the lime.

Pipes exposed may be prevented from bursting in freezing by a very simple device. Water, like everything else, contracts in volume, slightly, by cold to a certain point—the freezing point. Unlike everything else, water, as it freezes, suddenly expands with a force nothing can resist. Pipes and vessels of the toughest metals burst as easily as clay pipes from the freezing of water so confined in them as to permit no room for its expansion. If a short piece of rubber hose, securely tied at each end so as to prevent the air in it from escaping, is inserted inside the water pipe, about the point where it is most likely to freeze, it will prevent the bursting of the pipe. The expansion of the freezing water is counteracted by the compression of the air confined in the rubber hose and thus relieves the pressure on the pipe.

Correspondence.

How to Remove Green Scum.

To the Editor of the Scientific American:

I read an account in your paper dated October 22, 1892, *re* drinking water, etc., in San Francisco, which states that water in tanks, after a time, becomes covered with green scum.

I am in charge of the water supply of Hughenden, for which there is a large tank. I had noticed the accumulation of green scum, as mentioned, which I thought was caused by the sun. So had a covering erected (allowing an opening each side for the free play of the air), and have found that the water is now quite free from the accumulation. J. F. SCOTT,

Engineer in charge water works.

Hughenden, Queensland, Australia, Jan. 13, 1893.

Two Noted Entomologists.

BY PROF. C. V. RILEY.

The news of Professor Westwood's death, which reaches me while away from home seeking health, prompts me to send you a short notice of him, as also of another noted English entomologist who lately passed away.

HENRY TIBBATS STAINTON

was born August 13, 1822, and died December 2, 1892, at his home in Mountsfield, Lewisham, England. He had been ill for some months, growing each day feebler, but retaining his mental faculties till the last. Educated at home and at King's College, and for some years engaged in business, he early developed a fondness for entomology, and gradually worked more and more in the order lepidoptera and finally in the microlepidoptera, in which he came to be looked upon as the highest authority. He was a frequent contributor to the natural history periodicals of his time and originated "The Entomologist's Weekly Intelligencer" (10 vols., 1856-61) and "The Entomologist's Annual" (20 vols., 1855-74). He was one of the founders of "The Entomologist's Monthly Magazine" and one of its editors to the last, and was instrumental in founding "The Zoological Record." His separate works number a score, among the most important of which are the following:

"A Manual of British Butterflies and Moths," 2 vols., 1857, 1859, the best work of its kind ever published in the language.

"The Natural History of the Tineina," 13 vols., 1855-73, illustrated by colored plates and printed in English, French, German, and Italian. This is one of the classics in the science and served more than any other of his works to give him world-wide fame.

"The Tineina of North America," by Dr. Brackenridge Clemens, a collected edition of the latter's writings upon the subject, with notes by the editor, H. T. Stainton, 1 vol., 1872. This was a great help and stimulus to American students of the group, as Clemens' writings had been scattered through odd volumes of the Proceedings of the Philadelphia Academy of Natural Science and elsewhere.

I first had the pleasure of meeting Mr. Stainton in 1871, and on several occasions subsequently enjoyed the hospitality of his beautiful and secluded home at Lewisham.

Kind-hearted and modest, almost to a fault, he yet impressed one with his good sense and intellectual force. With ample means, he remained an industrious worker through life, and found his pleasure not in the vanities of society, but in quiet study and active interest in everything that tended to promote his favorite science.

JOHN OBADIAH WESTWOOD

was born at Sheffield, December 22, 1805, and had just completed his 87th year. He was educated in a Friends' school, and early evinced a love of natural history and great gift for drawing—two faculties that often go together. Though he began life as a lawyer he became more and more absorbed in science and literature, and finally made a specialty of entomology. There has been no more voluminous writer on insects, and no one of his generation whose luster outshines his. Almost all his contributions to knowledge were beautifully illustrated by his facile pencil, while some of his works, like his "Arcana Entomologica," are sumptuous in the richness of their plates. I will make no attempt to enumerate the many important works of one who was constantly publishing during a period of more than sixty years, but his "Introduction to the Modern Classification of Insects," though over half a century old, has justly been called the entomologists' Bible, and alone would have made him famous. He was a founder of the London Entomological Society, of which he has been for the last ten years honorary life member. But Westwood was not only an eminent entomologist, he was an authority in ivories and inscribed stones, and a noted archæologist. His talent, industry, and wide observation are exemplified in his "Palæographia Sacra Pictoria;" his "Facsimiles of the Miniatures and Ornaments of Anglo-Saxon and Irish MSS.;" his "Book of Kells," and his "Lapidarium Wallise."

I remember my surprise on one of my visits to his home in Oxford—an old fashioned English mansion in the midst of a beautiful garden—at the great industry and extensive travel which these works and his archæological collections indicated.

While he did a great deal of descriptive work in entomology, he was most deeply interested in the biologic side of his favorite science, and fully appreciated the importance of its economic bearings. He was the first to characterize one form of the notorious grape phylloxera as *Peritymbia vitisana*, and was a constant contributor to the *Gardeners' Chronicle*. He met with an accident some five years ago which influenced his health, but did not prevent his working till the very end. He was of the true Saxon type, simple and hearty in disposition, with fair and kindly face, long flowing side and chin beard, and beautiful large blue eyes which twinkled with humor. Of late years he held the Hope Professorship of Zoology in the University of Oxford, and he was fond of relating how some question as to his religious views, when his appointment was being considered, was set at rest by a happy *mot* of the public orator—that he was not a "sectarian," but an "insectarian"!

Hot Springs, N. C., January 23, 1893.

NEW MERCURIAL COMPENSATION PENDULUM.

Of the different compensation pendulums hitherto employed, the mercurial compensation pendulum, invented in 1721 by Graham, of England, enjoys the best reputation, for which reason it has been used in nearly all astronomical and other pendulum clocks of precision.

But this pendulum has defects, among which are incorrect functioning when the temperature of the air differs at different levels, and sensitiveness to sudden changes of temperature. Besides, the shape of the Graham pendulum prevents it from cutting the air easily, and consequently changes in the atmospherical pressure exercise a comparatively strong influence on the running of a clock having such a pendulum.

Riefler's Mercurial Compensation Pendulum.

The defects are almost entirely obviated by the mercurial compensation pendulum of S. Riefler, of Munich, shown in the cut, which illustrates a seconds pendulum one-tenth of actual size.

It consists of a steel tube, bore 16 mm., thickness of metal 1 mm., filled with mercury to about two-thirds of its length. The pendulum has, further, a metal bob weighing several kilogrammes and shaped to cut the air; below the bob are disk-shaped weights, attached by screws, for correcting the compensation, the number of which may be increased or diminished as appears necessary.

While in the Graham pendulum correction is effected by altering the height of the column of mercury, in this pendulum it is effected by changing the weight of the pendulum, leaving the height of the column of mercury the same.

The inventor states *that the probable error of compensation in these pendulums will not exceed* ± 0·005 *second per diem and* ± 1° *variation in temperature.*

A number of these pendulums have already been constructed, some of which have been running for more than a year. They are in use in the observatory in Munich, giving great satisfaction. The precision of this compensation, which was discovered by purely theoretical computations, has been thoroughly established by the records of their running at different temperatures.

The adjustment of the pendulums, which is, of course, almost wholly without influence on the compensation, can be effected in three different ways:

(1) The rough adjustment, by screwing the bob up or down.

(2) A finer adjustment, by screwing the correction disks up or down.

(3) The finest adjustment, by putting on the additional weights.

These weights are to be placed on a cup attached to the rod of the pendulum. Their shape and size is such that they can be readily put on or taken off while the pendulum is swinging. Their weight bears a fixed proportion to the static momentum of the pendulum, so that each additional weight imparts to the pendulum, for twenty-four hours, an acceleration precisely expressed in seconds and marked on each weight.

Each pendulum is accompanied with additional weights of German silver for a daily acceleration of 1 second each, and ditto of aluminum for an acceleration of 0·5 and 0·1 second respectively.

A pointer is attached to the lower end of the pendulum, for reading off the arc of oscillation.

These pendulums are delivered with the compensation fully adjusted, thus avoiding all correction of the compensation, such as is necessary with all other compensation pendulums, and can generally be arrived at only after tedious experiments.

Launch of a Great Battle Ship.

An ironclad battle ship of the first order was launched at the Cramps' shipyard, Philadelphia, on February 28, and was christened the Indiana. She is the largest vessel built thus far on this side of the Atlantic, and the launch was witnessed by President Harrison, Secretary Tracy, and a large number of distinguished guests. She is of 10,200 tons displacement, having a length of 348 feet, a breadth of 69¼, and a mean draught of 24. The contract price for her hull and machinery is $3,020,000. The engines are twin screw, of the vertical, triple expansion, direct acting, inverted cylinder type, placed in water-tight compartments separated by bulkheads. The diameters of the cylinders, high pressure 34½ inches, intermediate 48 inches, low pressure 75 inches, stroke 42 inches. The condensers are of composition and sheet brass, each main condenser having a cooling surface of 6,358 square feet. The circulating pumps are centrifugal and independent. There are four double-ended and two single-ended auxiliary steel boilers of the horizontal return fire tube type. The main boilers will be about 15 feet outside diameter and 18 feet long, and the auxiliary single-ended boilers will be about 10 feet 2 inches diameter and 8½ feet long, all constructed for a working pressure of 160 pounds per square inch. Each double-ended boiler will have eight corrugated furnace flues 3 feet internal diameter. The total heating surface of the main boilers is 17,460 square feet and grate surface 552 square feet. The auxiliary boilers have a grate surface of 64 square feet and a heating surface of 1,937 square feet. The vessel has a powerful ram bow, and is divided into a great number of water-tight compartments by means of longitudinal and transverse bulkheads of 10 and 12 pound plates.

According to Secretary Tracy, the battery of the Indiana will be "the heaviest and most effective in battle carried to-day by any ship afloat or projected, and its disposition is such as to make it tell with terrific effect. Above the armored deck, 80 feet from the center of the ship, rise two redoubts, inclosing the foundations of revolving turrets, within which are the four great 13-inch rifles, 18 feet above the water, and sweeping through a clear arc of 270 degrees, forward and aft and on both broadsides. Above these, on the heavy superstructure between the turrets, 25 feet above the water line, and therefore capable of firing over the turrets, are eight 8-inch rifle guns that, at two miles, can pierce the armor of many modern ships. Four 6-inch guns complete the main armament. The secondary battery consists of sixteen 6-pounder rapid-firing guns, four 1-pounders, and four Gatlings, so disposed that a rain of projectiles can be thrown upon every point of approach, sufficient to destroy any light boat that may venture within range."

Of the six torpedo tubes, one is fixed at the bow and another at the stern, while on each broadside are two others, firing through five inches of protection.

The armor of the Indiana has a water line belt, 3 feet above and 4½ feet below the water line, making 7½ feet in total breadth of armor 18 inches thick. It extends along three-fourths of the ship, and turns in forward and aft, where it sweeps around the base of the redoubts. These latter are 17 inches thick, and extend 3½ feet above the main deck. They protect the turning gear of the turrets and the loading. The turrets have 17 inches of armor, at first planned to be inclined but now vertical.

There are also heavy, under-water, sloping, protective decks, while water-excluding material on the slopes of the decks, the protection of the coal bunkers, and many watertight compartments will assist in her invulnerability.

Impressions in Sulphur.

M. Lepirre, a French artist, states that in demonstrating that sulphur melted at about 115° can be cooled in paper, he happened to use a lithographed card, of which the edges were turned up. Upon taking away the card it was discovered that the lithographed characters were clearly and distinctly impressed upon the cooled surface of the sulphur, remaining thus after hard friction and washing. By repeated experiments in this direction he has succeeded in obtaining results of a very satisfactory character, removing the paper each time by a mere washing and rubbing process. It is found, in fact, that sulphur will receive impressions from and reproduce, in a faithful manner, characters or designs in ordinary graphite crayon, colored crayons, writing ink, typographical inks, china ink, lithographic inks—whether colored or uncolored varieties—and others. He also states that it will reproduce with remarkable exactitude maps.

ICE IN THE SUBWAY.

A few days ago, when the men opened the Canal Street electric light subway, in this city, in order to put a wire in, they found the conduits full of ice and impossible to get the wire in. The difficulty was overcome by the method illustrated in our engraving. A bellows 12 inches in diameter, to which was attached a ¾ inch iron pipe, 6 feet from the bellows. There were three coils in the pipe. Around this was built a fire. The pipe then led into the subway conduit. A man worked the bellows, forcing the air through the pipe. As it passed through the coils the air became heated, and was then forced into the conduit to thaw the ice. The electric light subway in Canal Street has five conduits, each capable of holding five cables of 100 wires each. The largest subway is the telephone and telegraph subway in Cortlandt Street. It has 116 conduits, each holding 102 wires. It is at present very nearly full. This is the first time since the subways have been built that the conduits have had ice in them.

FORCING HOT AIR INTO THE SUBWAYS, NEW YORK.

A REMARKABLE INSTANCE OF RECENT EROSION.

BY H. C. HOVEY.

A formidable ravine has been created by erosion, at Crawfordsville, Indiana, within the memory of many living witnesses. In order to understand its peculiar features we must first recall some salient facts concerning the geology of the region. The tertiary rocks are altogether wanting. Limestones, rich in marine fossils of the lower carboniferous age, lie in nearly horizontal strata, with few signs of seismic disturbance. The soil is fertile and used to be clothed with magnificent forests, now mostly felled. The general surface is flat, or gently undulating, except as broken by glacial and post-glacial action, in the form of moraines and ravines of drainage. In other words, there are no hills caused by upheaval. Cutting through the loam and subsoil, we usually find but a few yards of gravelly clay before striking the underlying rocks.

Here and there, however, and without any marked change of the surface, the drift is found to have an extraordinary depth. Could the soil and drift of middle Indiana be wholly removed, we should find the denuded rocks carved into numerous basins, which must have been full to the brim when the great glacier of the ice age came down from the north. These pre-glacial lakes must have been frozen solid by the intense cold that heralded the glacier's approach. The advance and retreat of the ice would override the frozen basins, as well as the limestone ledges, spreading over the entire region its burden of debris brought down from the highlands of Canada. This load was made up of primitive rocks rounded into bowlders, crushed into sand, or decomposed into clay. In many cases, as we may suppose, the drift would gradually displace the contents of the basins. But in other cases the basin ice would lie for a long time buried under an arch of stratified drift, and when it finally thawed it would exist as a mass of water-bearing clay or as a subterranean lake.

The city of Crawfordsville is built directly over such a hidden reservoir. The citizens found to their surprise that while one man might sink a well fifty feet or less and find an inexhaustible supply of the purest water, his neighbor's well would be dry at a depth of a hundred feet, or else would reach some scanty vein of water impregnated with mineral impurities. The sulphur springs of the valleys also must have had a different source from the wells of limpid water. The fact that the latter were limited to a definite area led us to conclude that these shafts touched a subterranean lake, or its equivalent bed of saturated clay or sand.

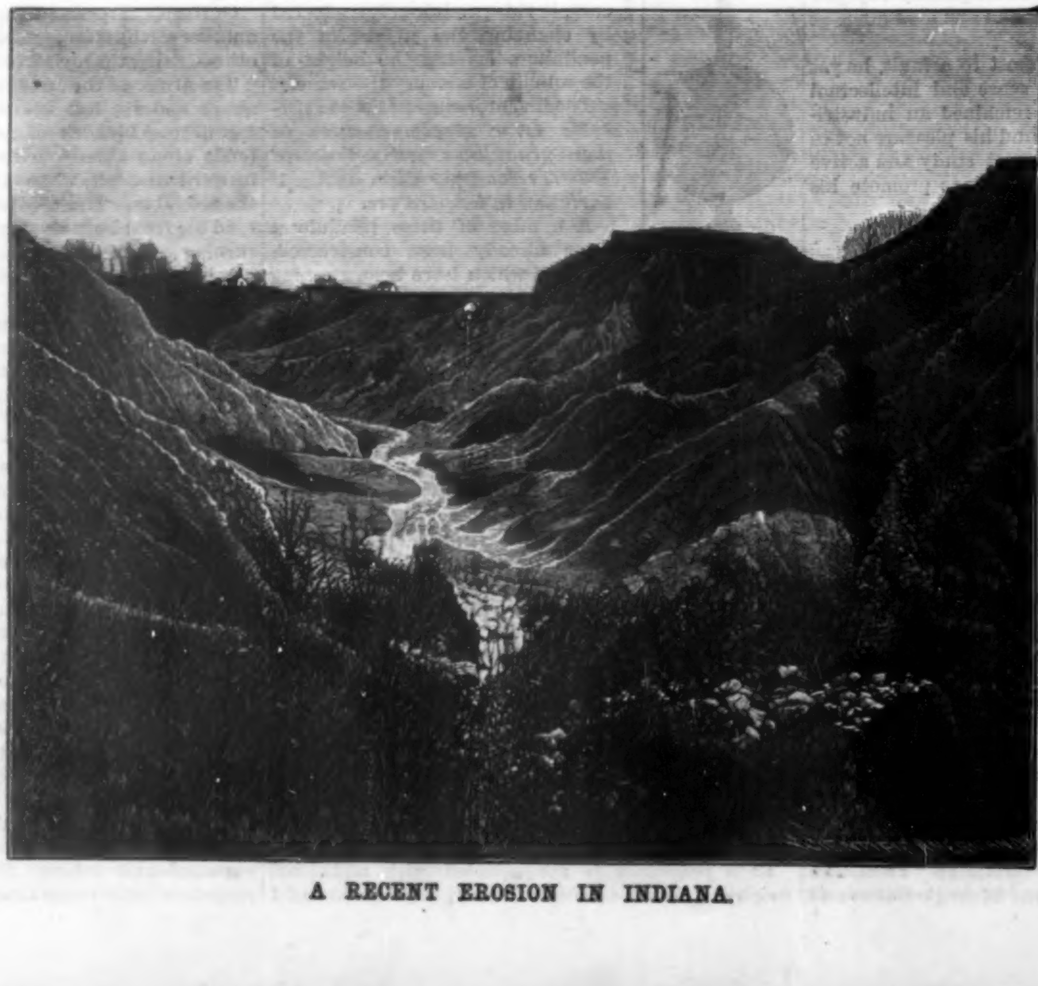
The plateau, or what may be described as such, on which the city stands, is broken along its northern boundary by abrupt bluffs of stratified drift, at whose base flows the river known as Sugar Creek. Both above and below these bluffs the stream cuts through the solid limestone walls of the pre-glacial lake. Similar walls are found by going a mile or so in other directions. The depth of the ancient basin may be inferred from the fact that the bluffs now rise to the height of 60 or 80 feet above the river, while recent borings just across the stream have been made through drift to the depth of 150 feet below water level, without reaching the underlying rock. Mr. Charles Beachler is making a special study of this old lake basin, with promise of interesting results.

In my boyhood I saw those bluffs in their natural condition, as they had been kept from erosion, probably for ages, by the roots of dense thickets and great trees. But in 1845 the local authorities, ignoring the warning given to those on a sandy foundation, turned the drainage of the city in the direction of the bluffs. Parallel ditches were plowed from Green and Washington streets to the edge of the bluffs, and the trees and briars were cleared away. The result was a rapid and wonderful transformation. The ditches became gullies, and the gullies grew into ravines, while men went about their daily business unconcerned. As early as 1850 the writer surveyed the ravages already wrought, and noted the broad acres that had even then been swept into the river to such an extent as to modify its channel materially. He went on a fruitless errand to the authorities, who only laughed at his boyish fears.

After a while more influential voices sounded the alarm, and a sturdy fight was begun, to prevent the ruin of the northern part of the city. Strong dams were built; but the water seemed to delight in undermining logs and rocks, and in setting human ingenuity at defiance. The two ravines, from the two streets named, united at a point considerably back from the bluff, leaving a kind of island on which was a cottage and a garden as recently as ten years ago. The island is now reduced to a singular peak, sixty feet high, with a flat top only a few feet square.

As the erosion progressed it finally tapped the subterranean lake to which reference has been made. A powerful stream burst forth from the wall of the ravine, and hundreds of people went to see the alarming phenomenon. Numerous adjacent wells went dry. The stream thus suddenly created continues to flow, but with diminished volume, owing partly to the caving in of the walls of the ravine, and partly, perhaps, to the draining of the reservoir. This matters less than it might have done formerly, for now the city obtains an admirable supply of water from artesian wells. By means of suitable sewer pipes the drainage is now conveyed to the river in a manner to obviate further washing from that cause. Washington street has also been carried down through the lower ravine to the level of the stream.

By dint of persevering efforts and incessant vigilance the work of erosion is finally under control, so that no further injury need be feared for the beautiful and growing city on the bluffs. But the existing ravines, formed within a period of about forty-seven years, with their canyons, peaks, cliffs and terraces, look more like some region in Arizona than any portion of the Hoosier State. The accompanying illustration is from a photograph by Professor M. B. Thomas, of Wabash College.



A RECENT EROSION IN INDIANA.

COLONEL H. W. FEILDEN, in the course of an interesting paper on animal life in East Greenland, contributed to the February number of the *Zoologist*, suggests, as he has done before, that the musk ox might with advantage be introduced into Great Britain. He sees no reason why it should not thrive on the mountains of the Highlands of Scotland. In the winter season the musk ox is covered with a long-stapled fine wool besides its coat of hair. This wool is of a light yellow color, and as fine as silk. Sir John Richardson states that stockings made from this wool were more beautiful than silk ones. Young musk oxen are very easily reared and tamed, and Colonel Feilden thinks there could not be any great difficulty in catching either old or young in Jameson's Land. The government has lately introduced the reindeer from Russia into Alaska. It would not be a bad idea to try an importation of the musk ox from Greenland.

UNITED STATES STEAMSHIP IOWA.

In the battleship bearing the above name the United States government will possess a vessel of great power and endurance, fully able to cope with any vessel of her size afloat. She was designed by the Navy Department to meet the requirements of the naval appropriation bill of July 19, 1892, calling for a battleship of about 9,000 tons displacement and not to exceed a cost of $4,000,000, the size and cost being based upon the United States steamships Indiana and Massachusetts now building. The preparation of the design was intrusted by the Secretary of the Navy to Commodores Wilson and Melville, and so well have they performed the task that a vessel 1,000 tons larger than the Indiana is to be built within the same limit of cost. The dimensions of the Iowa are as follows:

Length on load line	360 ft.
Beam extreme	72 " 2½ in.
Mean draught	24 "
Displacement	11,296 tons.
I. H. P.	11,000
Speed, in knots, per hour	16
Coal bunker capacity	2,000 tons.

The main battery consists of four 12-inch breechloading rifles and eight 8-inch breechloading rifles mounted in turrets. The 12-inch gun turrets are armored with solid steel plates of 15 inches thickness, and the 8-inch guns are protected by armor of 8 and 5½ inches in thickness. All this armor is treated by the Harvey process, which gives the plates a casehardened surface, gradually shading off to a soft back.

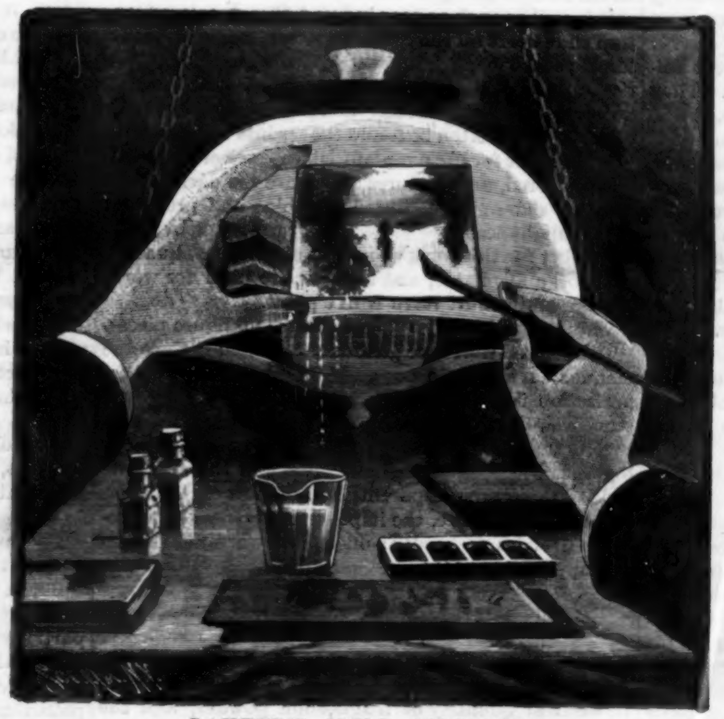
The secondary battery is made up of six 4-inch rapid-fire breechloading rifles. These rifles throw a shell weighing thirty-six pounds, and are capable of being fired ten times per minute. These guns are protected with light armor against machine gun fire, and are disposed so as to have as great a range of fire as possible. The auxiliary battery consists of twenty 6-pounder and nine 1-pounder machine guns, with six torpedo tubes.

The protection to the hull and machinery is afforded by a steel belt of 14 inches maximum thickness, covering over seventy per cent of the load line. This belt extends from 4 feet 6 inches below the load line to 3 feet above it. Above this belt to the main deck bevel between the 12-inch gun turrets, a belt of 4-inch armor is worked to cause shell loaded with high explosives to break up before entering the vessel. On top of the 14-inch armor a horizontal deck 2¾ inches thick is worked, and from the ends of the side armor to the extremities of the vessel a similar deck 3 inches in thickness is provided. Above the armor decks, belts of cellulose to prevent the inrush of water in the event of the vessel being injured are provided. The hull is built on the cellular system, with inner bottom, and great attention has been given to the subdivision of the vessel into a large number of watertight compartments, each provided with its own means of pumping and draining.

The machinery and boilers are arranged in six watertight compartments. The engines are of the inverted, direct-acting, triple-expansion type, driving twin screws. The smoke pipes are in height 100 feet above the grate bars, and the performance of the boilers under natural draught is expected to be a great improvement over boilers in existing naval vessels.

The ventilation and incandescent lighting plants of the vessel have been especially studied, in order to insure comfort and health to all on board.

Electric search lights of great power are provided, capable of lighting up a zone about the vessel through which no torpedo vessel can pass unnoticed, and the machine guns are so disposed as to bear upon all portions of this zone, and should a craft by any means get through this area of light and gun fire, stout torpedo nets reaching from water line to keel are ready to receive the torpedoes discharged.



LANTERN SLIDE COLORING.

HOW TO COLOR LANTERN SLIDES.

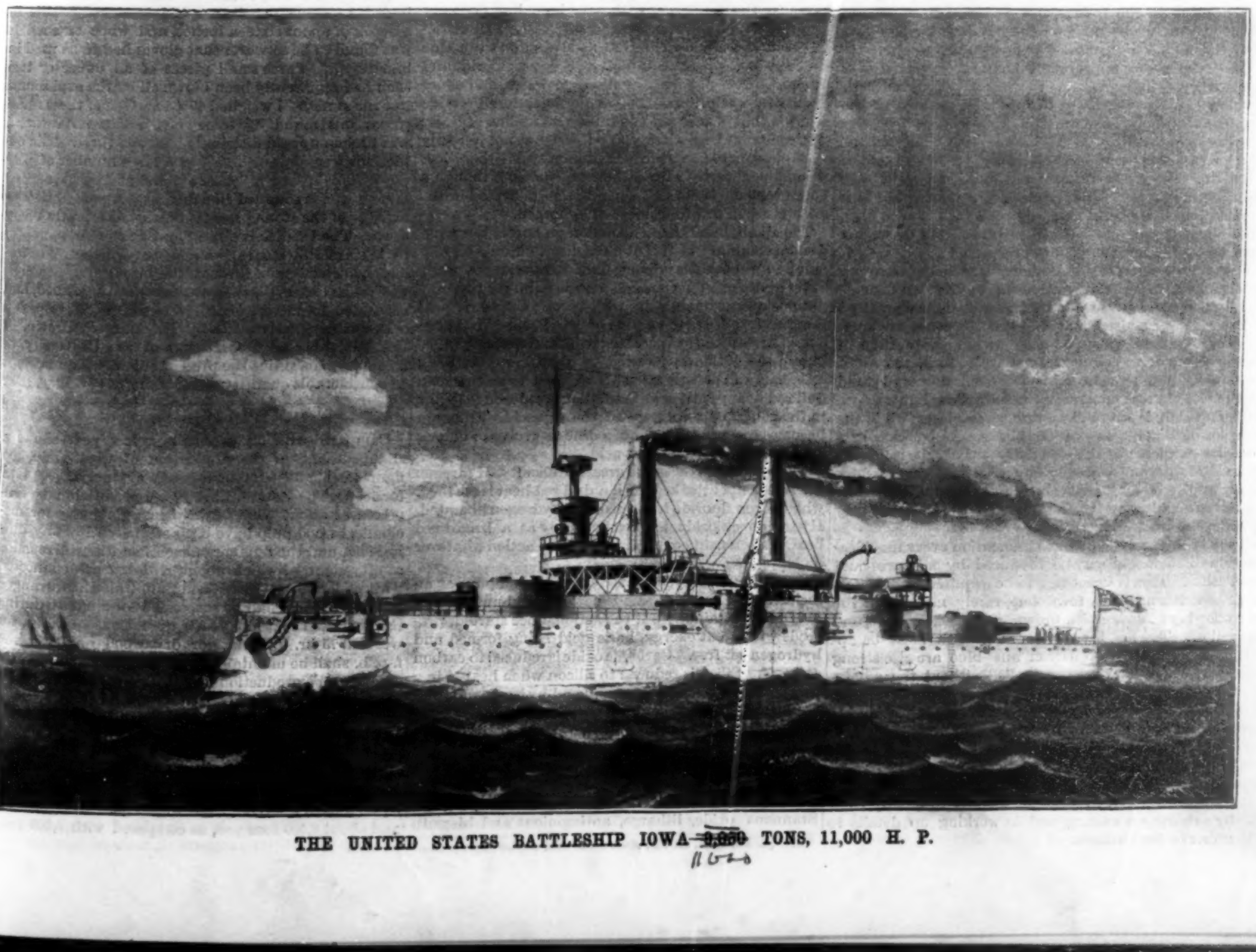
BY GEO. M. HOPKINS.

Nothing is more interesting and satisfactory to the amateur photographer than to place upon the screen, by means of a good lantern, the results of the summer's work; and, while it may be questioned whether anything can be more desirable for projection than a really first-class, well-toned lantern slide, yet experience proves that the majority of people who enjoy an evening with the lantern are pleased when a well-colored slide is shown.

A suitable subject carefully printed and artistically colored, when reflected from the screen, strongly resembles a huge water color picture, the great difference between such a picture and a water color being a superabundance of detail, which is inherent in photographic pictures and which is not desirable in a water color. A photo. can be made which will answer admirably for coloring which would not be satisfactory as an uncolored picture. Such pictures are taken through a large diaphragm or with full opening. The foreground is made sharp, while the middle distance and distance are softened down by being a little out of focus; however, it is not advisable to try to make negatives expressly for colored pictures.

The print for coloring should be moderately light and without great contrasts. Inky shadows are to be avoided, and it is well to vignette off the distance to give atmosphere. The sky should be transparent, unless cloud effects are to be shown. While specks, pin holes, and lint are very damaging to an otherwise fine lantern slide, they entirely spoil a picture for coloring. In a picture well broken up, as in a woods scene, where little sky appears and when there is no placid water, these small defects do little harm; but in a sky or in a clear lake or pond, they can never be concealed or removed so as to be unnoticed, so that the first requisite for a good colored lantern slide is a good print of the proper intensity, and with transparent lights. The second requisite is a knowledge of colors and coloring, and the third and last thing needed is an assortment of colors and brushes.

With regard to the slide itself, it might be mentioned in passing that anything which tends to harden the film in developing, fixing, or after treatment interferes with the free working of the colors. For instance, alum in the fixing bath, intensifying and re-



THE UNITED STATES BATTLESHIP IOWA—~~9,650~~ TONS, 11,000 H. P.
11520

ducing solutions all tend to harden the film and prevent the free absorption of color.

The first operation in lantern slide coloring is to soak the plate in cold water until the film will absorb no more; then while it is still wet, go over the entire surface of the film with a thin wash of warm color, which may be either yellow or pink, depending upon the subject. This kills the chalky whiteness of the high lights, and gives the entire picture a warm and desirable tone, even though the wash is not sufficiently strong to be detected when the picture is thrown upon the screen.

The colors used for this purpose are transparent aniline colors prepared for coloring photographs. They are labeled brown, blue, violet, flesh, orange, green, and so on. The ordinary aniline dyes may be used instead of the prepared colors, as they are practically the same. The manipulation of the colors is the same as in water color painting. The film is kept wet continually from the beginning to the end of the operation, but after the broad washes of the first warm tint and the final sky color, the water lying on the surface of the film is allowed to dry off, leaving the film still swelled and wet, but without the surface water.

The prepared colors can rarely be applied to the slide without being reduced with water. Sometimes the best effects are produced by mixing different colors before applying them, while in other cases the effects are secured by separate washes of different colors, superposed. Each wash of color sinks into the film and is not removed by a subsequent wash.

Although an easel or support something like a retouching frame may be useful, the writer prefers to hold the slide in the hand, as shown in the engraving. The wet plate is held in a slightly inclined position in front of a lamp provided with a plain opal or ground glass shade. The writer prefers artificial light for coloring, as the pictures are to be shown generally by artificial light which is yellow. If the pictures are designed for projection by sunlight, it is undoubtedly better to color them in daylight.

The first wash is preferably put on while the slide is held in an inverted position, and while it is still flowing the blue is added for the sky, at first very light near the horizon, increasing in intensity toward the top of the slide. After this wash is set and superfluous water has evaporated, the water accumulating along the lower edge of the plate is removed with the fingers, and the slide is turned right side up, when the extreme distance, whether it be mountain or foliage, is covered with a light wash of blue, and this wash is brought well down toward the foreground. If the blue appears cold, it can be toned down by a very light wash of yellow or red. Trees in the middle distance can now be gone over with a light wash of orange or orange with a little of the flesh color or pink added. When near the foreground a very light wash of green is applied to the foliage, but the raw green of the color set cannot be used for this; it must be modified by the addition of orange or of brown. If when applied the green appears too cold, it may be toned down by a light wash of brown, of orange or flesh color. It is desirable to produce variety in the foliage.

Rocks in the distance are washed with blue and the color is subsequently modified by washes of red or brown. Trunks of distant trees and some rocks may be left nearly the original color of the photo., but near rocks and tree trunks may be tinted with brown, blue, or warm green, and subsequently modified by washes of green, red, brown, yellow, or orange.

It is useless to trace the smaller branches of trees and shrubs, and it is rarely necessary to deal with single leaves or blossoms; when this must be done a jeweler's eye glass is required, and fine, small brushes are used, great care being taken to keep within the outline of the object being colored. In all this work, the artist does well to remember that the coloring is to stand the test of great magnification and strong light.

The plate is apt to dry out in some places while the coloring is going on at other places. As coloring cannot be successfully done on a dry surface, it is important to wet the surface before proceeding. This is done by applying water with a soft camel's hair brush. After the surface water has disappeared the coloring may proceed.

It is obviously impossible to mention every modification of color that may be produced by mixtures and washes. This is something to be acquired by practice. The writer uses very few colors, rarely more than the following: Blue, green, brown, orange, flesh, rose, and yellow. The last is a strong color which must be applied with caution. Green and blue are also strong colors which can never be applied without the admixture of a warm color, or a subsequent wash of the same. Brown in different strengths has a large application. It is useful in toning down bright greens, for rocks, tree trunks, earth, etc. A wash of blue over the brown produces a different but useful gray.

The principal points to be observed are to keep the plate always wet, to use light washes, to modify color by subsequent washes, and in working up details to preserve the outlines.

Should a small area be over-colored, the color may generally be partly removed by means of a soft brush charged with clean water, the brush being gently and repeatedly passed over the spot. The brush is frequently washed during the operation. When the broad washes show streaks, or when the entire slide is too highly colored, or the effects are unsatisfactory, the only remedy is to place the slide in cold water and allow it to soak, with occasional changes of water, until the color is partly or entirely removed.

It is well enough to bear in mind that a colored lantern slide bears all the color that is to appear on the screen; consequently, it must be more highly colored than a transparency for direct vision. On the screen, however, a picture is better under-colored than over-colored. It will often be found that prints which are too light and flat for use as plain slides answer very well when colored, and pictures which are too dark for use as plain slides may be tinted with blue and presented as moonlight scenes.

Brushes for this work should be of the best quality, very soft and pliable, and such as are used for working up detail must have a fine point.

This method applies to portraits and figure pieces.

The colored slides are generally mounted in the same manner as the plain ones. If, however, the highest perfection is sought, thin plate glass is used for the sensitive plates, and glass of the same kind is used for covers, the cover and colored picture being cemented together with Canada balsam. Made in this way, the slides are more transparent; but, in view of the extra trouble and expense, the improvement over the uncemented slides is hardly sufficient to warrant the general application of this method.

Boron.*

BY H. MOISSAN.

A summary of the properties of pure amorphous boron. Boric acid is twice treated with less than the theoretical quantity of magnesium powder, and the product, on treatment with an acid, leaves amorphous boron.

Amorphous boron is a bright, maroon-colored powder, which stains the fingers and can be compressed into a cake. Its specific gravity is 2·45. It does not fuse at the temperature of the electric arc, but shrinks slightly and increases in density when heated to 1,500° in an atmosphere of hydrogen. Its electrical conductivity is very low, the specific resistance being 801 megohms.

Boron takes fire in the air at 700°, and burns in oxygen with a brilliant green flame, having little actinic power; in either case the combustion is soon stopped by the formation of a layer of boric anhydride on the surface of the boron. It combines energetically with sulphur at 610° to form a sulphide, which is decomposed by water with evolution of hydrogen sulphide. It behaves in the same way with selenium, but does not combine with tellurium.

Boron burns in dry chlorine at 410°, and in bromine vapor at 700°, with the formation of boron chloride and bromide. It is dissolved by bromine water, and more readily by a solution of bromine in potassium bromide solution, but it does not combine with iodine.

It combines with nitrogen at 1,230°, but not directly with phosphorus, arsenic, or antimony. Neither does it combine directly with carbon or silicon, although a boron carbide is formed when boron is heated in the electric arc in an atmosphere of hydrogen.

The alkali metals have no action on boron, but magnesium combines with it at a red heat. Iron and aluminum form borides only at high temperatures, while silver and platinum combine with it quite readily.

Acids react energetically with boron; sulphuric acid is reduced at 250°; the action of nitric acid is so vigorous as to raise the temperature to incandescence; phosphoric anhydride is reduced to phosphorus at 800°; arsenious and arsenic acids are reduced to arsenic at a dull red heat; iodic acid in solution is reduced to iodine in the cold, and a mixture of the dry acid with boron becomes incandescent, and iodine is evolved; chloric acid is reduced to chlorous acid.

The hydracids react with greater difficulty. Hydrogen fluoride is not attacked until a dull red heat is reached, when boron fluoride is formed and hydrogen liberated. Hydrogen chloride is attacked only at a bright red heat, while its aqueous solution has no action whatever on boron.

Sulphurous anhydride is reduced to sulphur at an incipient red heat. Steam is not attacked until a full red heat is attained; but the action, once started, proceeds with great energy, boric acid being formed and hydrogen set free. Carbonic oxide is reduced to carbon at 1,200°. Silica is reduced to silicon when heated in a forge. Nitrous oxide is decomposed by boron at a dull red heat, boron nitride and boric acid being formed; nitric oxide is not affected by it.

Metallic oxides are more readily reduced by boron than by carbon. When, for instance, a mixture of boron and cupric oxide is heated in a glass tube, the reaction which ensues is so violent as to melt the glass. Stannous oxide, litharge, antimonious and bismuth oxides are all readily reduced. A mixture of boron and lead peroxide detonates violently when triturated in a mortar. Ferric and cobaltous oxides are reduced at a red heat, but the oxides of the alkaline earths are not affected. Hydrogen is liberated by boron from fused potassium hydroxide. A mixture of boron, sulphur, and niter deflagrates at a dull red heat, while small quantities of boron projected into fused potassium chlorate burn with a most dazzling flame.

Boron acts very energetically on the metallic fluorides; it decomposes the fluorides of the alkalies and alkaline earths at a bright red heat; zinc fluoride at a dull red heat, boron fluoride being formed; and it acts with even explosive violence on lead and silver fluorides. Its action on the metallic chlorides is not so energetic. The chlorides of the alkalies, the alkaline earths, zinc, and lead are not attacked at a red heat, but mercurous chloride is reduced to mercury at 700°. Lead, zinc, cadmium, and copper iodides are not reduced by boron, but tin and bismuth iodides are reduced with facility. Potassium, sodium, calcium, and barium sulphates are reduced by boron at a red heat to the corresponding sulphides.

Nothwithstanding its great affinity for oxygen, boron may be immersed in fused potassium nitrate without any reaction occurring, provided the temperature is below that at which oxygen is disengaged. Fused potassium nitrite, however, is decomposed by it with great violence. Sodium carbonate is reduced at a dull red heat, potassium carbonate at a somewhat higher temperature, and calcium and barium carbonates not at all.

The arsenites, arsenates, and chromates are all reduced at a dull red heat.

Boron behaves also as a reducing agent in the wet way. It reduces potassium permanganate solution, partially in the cold, entirely on heating. It reduces ferric chloride to ferrous chloride. It precipitates silver from silver nitrate solution in fine crystals, and reduces palladium, platinum, and gold from solutions of the chlorides of these metals.

Boron thus combines with the non-metals much more readily than with the metals. It is a more powerful reducing agent than either silicon or carbon, and, on the whole, is most nearly allied to the latter element. —*Am. Jour. Pharm.*

* *Compt. Rend.*, 114, 617-622; *Jour. Chem. Soc.*, October, 1892, p. 1152.

The Dakota Meteoric Stone.

BY A. E. FOOTE.

On the 29th day of August, 1892, about 4 o'clock in the afternoon, while Mr. Lawrence Freeman and his son were stacking upon his farm two miles south of Bath, they were alarmed by a series of heavy explosions. On looking up they saw a meteoric stone flying through the air, followed by a cloud of smoke. Its course was easily traced to the point where it fell, within about twenty rods from where they were standing. The stone penetrated the hardened prairie to a depth of about sixteen inches, and when reached it was found to be so warm that gloves had to be used in handling it. Three small pieces of an ounce or two each had apparently been blown off by the explosions, but the stone still weighed 46¾ lb. One of these small pieces was found by some men not far distant, and was broken up and distributed among them. The explosions were plainly heard by a large number of people at Bath, two miles away, and at Aberdeen, nine miles away, it sounded like distant cannonading. The exterior of the stone presents the usual smooth black crust. The interior is quite close grained, resembling in texture the stones from Mocs. The iron is abundantly disseminated through the mass; and although the grains are small, they are easily distinguished, and separated on pulverizing.

Preliminary tests made by Mr. Amos P. Brown, of the Mineralogical Department of the University of Pennsylvania, prove the presence of nickel and cobalt in considerable quantity.—*Amer. Jour., January*, 1893.

Wood Pulp.

Compared with its predecessor, last year shows a slight decline in the production of wood pulp, the figures being 210,000 tons for 1892, against 230,000 tons for 1891. The value of last year's production is estimated at about £420,000. No manufactories for mechanical wood pulp have been erected in Norway during 1892, and the number of such factories still remains at fifty-eight, of which about a dozen are connected with paper mills. The Wood Pulp Union has arranged that operations shall be suspended for a month during the year, and that last year's quotations of 36 kr. for wet and 75 kr. to 80 kr. for dry wood pulp per ton f. o. b. shall be maintained. A considerable quantity of this year's production has already been sold. The market for chemical wood pulp improved during 1892, and prices were a little higher at its close than at the commencement. There are now in Norway eleven sulphite and four sulphate manufactories. Several of these are also connected with paper mills. The exports during 1892 of chemical wood pulp were about 20,000 tons dry, as compared with 17,500 tons in 1891, and about 8,500 tons wet, as compared with 9,500 tons in 1891.

THE CUNARD COMPANY'S NEW TWIN SCREW STEAMSHIP CAMPANIA.

We may correctly speak of the present as the twin screw era in the history of Atlantic navigation. It was inaugurated in 1888-89, when the four notable steamships, City of New York, City of Paris, Majestic, and Teutonic, were brought into the field, and it was soon further signalized by the introduction into the same service of the fine twin screw vessels built and owned by German and French firms—*e. g.*, the Augusta Victoria and Furst Bismarck, of the Hamburg-American line, and La Touraine, of the Compagnie Transatlantique. At the present time there are built, and building, as many as thirty-five twin screw steamships of over 5,000 tons, the Campania making the fifteenth vessel to be produced of over 6,000 tons.

The Campania is for the present the longest and most capacious steamship afloat, her 600 feet length between perpendiculars being only 80 feet short of that of the late Great Eastern, and her beam of 65·7 feet being 17 feet less than that of the defunct leviathan. The vessel in actual service most nearly approaching her in length is the White Star Teutonic, which is 566 feet between perpendiculars, or 34 feet less, the beam being 8 feet narrower. The Campania is 73 feet longer, but only 1 foot 9 inches broader than the Inman Company's City of Paris and City of New York. Her length over all is 620 feet; breadth extreme, 65 feet 3 inches; depth to upper deck 43 feet, and gross tonnage about 12,500 tons. Her displacement will probably be 18,000 tons. The vessel has a straight stem and elliptic stern, topgallant forecastle and poop, with close bulwarks, all fore and aft, and erections above the upper deck consisting of two tiers of deck houses, surmounted respectively by the promenade and shade decks.

The Campania is fitted with two sets of the most powerful triple expansion engines that have yet been constructed, each set capable, it is believed, of indicating from 14,000 to 15,000 horse power. These engines are fitted in two separate engine rooms, there being a dividing center line bulkhead between them, fitted with watertight doors for the necessary purposes of communication. Each set of engines has five inverted cylinders, viz., two high pressure, one intermediate pressure, and two low pressure cylinders, the two high pressure being placed tandemwise above the low pressure ones. These are arranged to work on three cranks set at an angle of 120 degrees with each other. The high pressure cylinders are each fitted with piston valve, the intermediate and low pressure with double piston valves, all of which are worked by the usual double eccentrics and link motion valve gear. Steam from the two high pressure cylinders exhausts into the intermediate one, which in turn exhausts into the two low pressure cylinders, which have relieved slide valves, expansion taking place in three stages. The reversing engines are of the steam and hydraulic direct-acting type made by Messrs. Brown, Brothers & Co., Edinburgh, and fitted with their patent automatic emergency gear. The condensing water is circulated through the condensers by four large centrifugal pumps, each driven by independent compound engines. These pumps may also, if required, pump water from the ship in case of damage to the hull. In the engine room are also fitted four evaporators of Messrs. G. & J. Weir's patent manufacture, to produce the necessary fresh water from sea water, and thereby make up the loss incurred through working and avoid the use of salt water in the boilers.

Steam for the main engines is generated in twelve large double-ended boilers, each having eight corrugated furnaces. The boilers are arranged in two groups of six, each group self-contained in water-tight compartments, and having a common funnel of the unprecedented diameter of 21 feet. The two funnels, it may be added, are from their lowest section 130 feet high, or about the height of the Eddystone Lighthouse. There is also a large single-ended boiler for supplying steam for the electric light, refrigerating, and other auxiliary machinery. In addition a small single-ended boiler is fitted on the lower deck for supplying steam to the distilling condensers, heating pipes, etc. An elaborate system of piping is fitted throughout the ship, and connected to the various auxiliary pumps for filling and emptying the ballast tanks, pumping out bilges, pumping water on deck in case of fire, and other purposes.

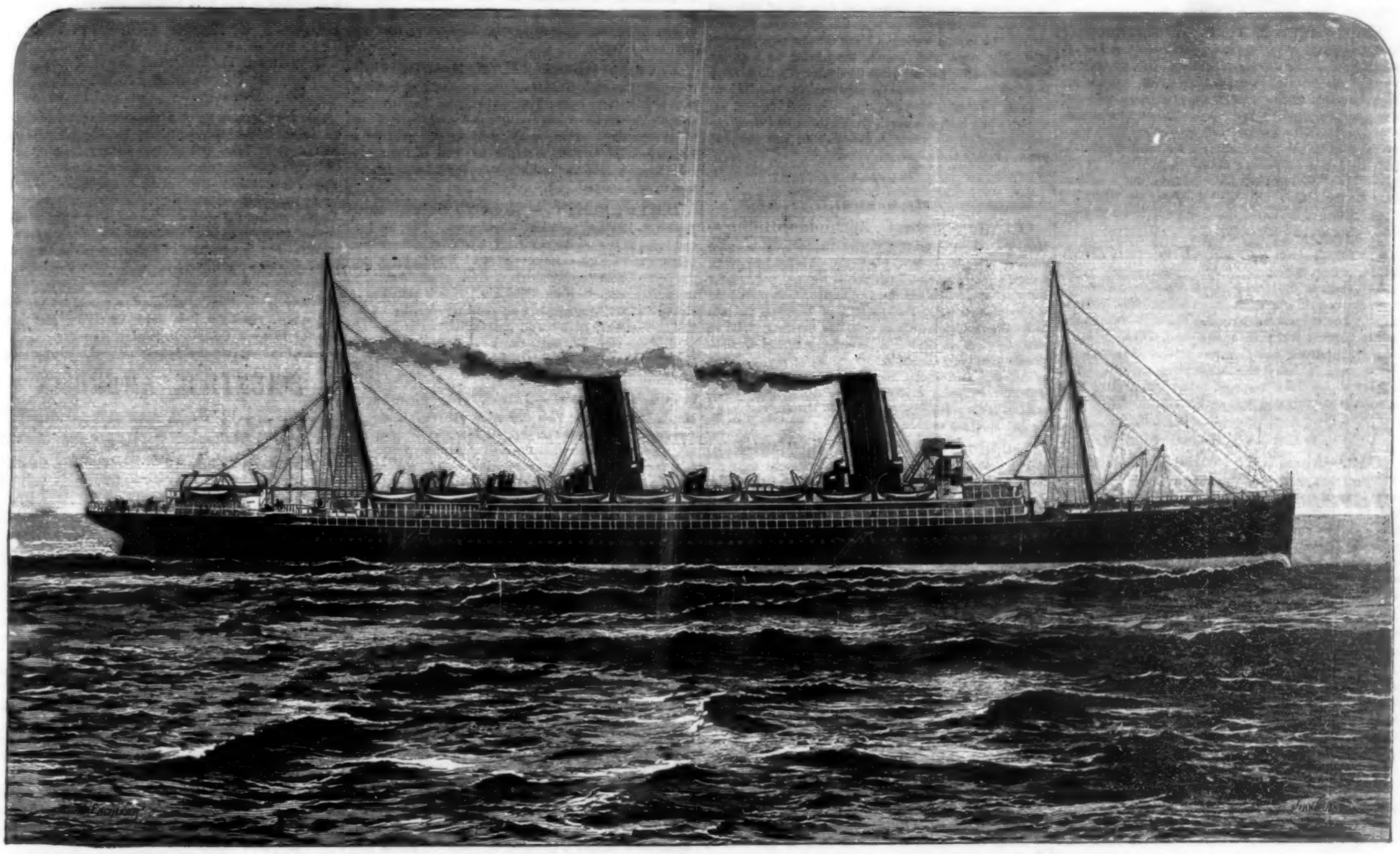
Her gigantic proportions considered, it will be readily understood that the greatest care and forethought have been expended on the structural arrangements and details throughout the huge vessel. Not only has the requisite continuity of strength been maintained throughout the entire length, in ways which experience has firmly established, but structural features have been introduced which may be said to be uncommon, if not entirely new, in shipbuilding practice, suggested, if not necessitated, by the conditions as to size and proportions.

The bottom of the vessel is constructed on the cellular principle for water ballast, minute water-tight subdivision being a feature in the arrangement. There are four complete tiers of beams, all of which are plated over with steel, and sheathed with wood planks, forming the upper, main, lower, and orlop decks. The last is used for cargo and refrigerating chambers, store rooms, etc. The other decks are entirely devoted to the accommodation of passengers, with dining and social saloons, state rooms, bath rooms, lavatories, etc., all on a scale of magnificence unequaled, no expense being spared on anything calculated to render traveling at sea more comfortable and enjoyable.

The electric installation on board—which is being carried out by Messrs. Siemens Brothers—is in keeping with the other marvelous details of the huge vessel. There are four sets of generating plant on board, each set consisting of a Siemens dynamo, coupled direct to a Belliss engine, which runs at the rate of 280 revolutions a minute, and gives an output of 42,000 watts. This is capable of supplying 1,350 16-candle power incandescent lights, including eight large reflectors of eight lights each, for working cargo, throughout the ship, and, in addition, a powerful searchlight for facilitating the navigation of the ship into port, the picking up of moorings and scouting in time of war. The large switchboard for controlling the lights consists of thirteen sections, so arranged that each may be connected with any of the four dynamos. From these dynamos and this large switchboard there runs throughout the ship an enormous amount of wiring, reaching, in point of fact, to upward of forty miles in length.

The Campania is expected to be completed in time for the rush across the Atlantic at the opening of the Chicago World's Fair.

We give an illustration of the ship as she will appear at sea, taken from a photograph courteously placed at our disposal by the Cunard Company. A fair idea of her size may perhaps be gathered from the statement that her funnels are each 21 feet in diameter, and the monkey bridge is 60 feet above the level of the water. We are indebted to the *Engineer*, London, for the foregoing particulars and for our engraving.



THE NEW CUNARD LINE STEAMER CAMPANIA—18,000 TONS, 30,000 H. P.

Massachusetts Institute of Technology.

The course in civil engineering was rearranged some six years ago in order to admit of certain training being given to the students, with special reference to their future work. To meet this requirement three options are offered to students during the fourth year: First, one in hydraulic and sanitary engineering; second, one in which particular attention is given to railroad engineering and management; and third, a special course in geodesy. These subjects are all, more or less, treated in the regular course, but particular attention is given to them in the different courses which permit the student to start upon his chosen branch of the profession with a fund of special information which could only be obtained elsewhere with great sacrifice of time and effort. The staff and equipment of the institute are excellent, and all who are interested in engineering should send for the pamphlet of the department of engineering.

THE *Canadian Architect* sensibly suggests that in building brick houses in positions where they are not protected by surrounding property, not to forget that hollow walls will add greatly to the convenience of the occupiers. They will render the house cooler in summer and warmer in the winter, and will assist in materially keeping the house dry. The cost of hollow walls is only very little higher than that of walls built solid.

RECENTLY PATENTED INVENTIONS.

Engineering.

SAFETY STOP FOR ENGINE GOVERNORS.—James Barclay, Sioux City, Iowa. This improvement consists of a stop adapted to support the governor sleeve when the steam is shut off, and to move from under the governor when the engine is running, the device being simple, durable, very effective, and automatic in operation. It is arranged to permit the governor, in case of accident, to drop sufficiently to throw the cams on the knock-off levers into action to prevent the cylinder from taking steam.

LOW WATER INDICATOR FOR BOILERS.—William H. Rodgers, Bay Side, N. Y. This invention provides a thermostatic device to indicate upon a dial connected with it the height of the water in the boiler, an improved construction being presented designed to reduce the cost of manufacture and simplify the device. An alarm device, governed by an electrical connection, is also connected with the indicator, to sound a signal when the water reaches too low a level.

FIRE BOX FOR STEAM BOILERS.—Micheal E. Herbert, St. Joseph, Mo. This fire box has side water legs closed at their top, bottom, and ends, a supporting water leg connecting the rear ends, while a water drum connects the forward ends of the side legs near the bottom, and tubular grate bars connect the drum and supporting leg. The fire box is adapted to dispense with fire brick lining and is designed to support the forward end of the boiler, while its construction is such that it may be used with various sized boilers or fronts, and may be quickly and easily removed for repairs and another one substituted in its place.

HOT WATER BOILER.—This is another invention of the same inventor, providing a boiler of extremely simple and inexpensive construction, designed to be very effective and operated at a small expense for fuel. It has a hollow top or water chamber mounted upon a series of water tubes, whose connected lower ends communicate with longitudinal circulating pipes connected at their front and rear ends by transverse pipes. A water leg is disposed centrally in the body of the boiler, and drop tubes are projected from the rear portion of the hollow chamber, the water leg forming a bridge wall over the top of which the fire passes to circulate among the rear drop tubes.

CONDENSING FUMES.—Frederick Mueller, Butte City, Montana. This invention relates to devices for roasting ore, providing an apparatus for heating the metal-carrying fumes, to separate the fumes from the metal. Located one above another is a series of compartments through which the fumes are caused to circulate, each compartment being formed with a water-dripping device, and the top compartment being charged with a liquid from a suitable reservoir. The device can be readily applied to any furnace, flue, or chimney.

Railway Appliances.

CAR.—Abram S. Desha, Nolton, Ark. This car has metallic sides and ends, with a lining attached by rivets, but with an interior space filled by mortar, while the floor and the top are of sheet metal. The car is burglar and fire proof, and is designed for use by railroad, express, and other companies, for carrying money and valuables. Ventilating openings in the top are adapted to be closed by gates, and the entire construction is simple and durable.

CAR DOOR.—This is a further invention of the same inventor, the improvement providing for two doors, one on the outside and the other on the inside of the car, the two doors being connected, and the construction being specially adapted for use on the burglar and fire proof car patented by this inventor. The outer and inner doors slide in the same direction, and the outer door is designed to be locked so that it can be opened only from the inside.

STREET CAR SUPPLEMENTARY TRUCK.—Bennett Price, Brooklyn, N. Y. These trucks each consist of an axle and two track wheels, to be located on the car below and nearer the platform than the main wheels, with upright screws and ratchet rigging for vertical adjustment. The improvement is designed principally to facilitate moving a street car over hose stretched across the track and similar obstructions, and also for use on the accidental breaking of a wheel or axle. By these trucks the car may be lifted so that its ordinary wheels will pass over an obstruction, the weight of the car during such movement being upheld by the supplementary trucks.

CAR AXLE BOX.—William Rader and Edwin Hunter, Allentown, Pa. This box has an improved sponge holder, a novel spring closer for the lid of the box, and improved means to restrain the escape of oil from the box at its inner side. The shell that forms a bearing for the journal of an axle is of the usual form, its location allowing for a suitable sponge-holding cavity beneath the journal.

CAR COUPLING.—James B. Baum and Oscar F. Sensabaugh, Durango, Col. The drawbar of this coupler is of the ordinary pattern, with a flaring mouth and aligning vertical openings, in which is suspended a novel form of pin, whose lower portion is so shaped that it may be raised by an entering coupling link. The coupling is simple, cheap, and strong, and designed to automatically couple with an opposing coupler, while uncoupling may be effected from the top and sides of the car.

RAILWAY CROSSING.—John R. Pflanz, Louisville, Ky. This invention provides improved constructions by means of which the intersecting rails are held in close contact with one another, the jolting or jarring of cars passing over the joint being entirely avoided, and a secure support being afforded for the short rails of the crossing. The main and crossin rails are jointed, and by means of a bearing plate within the chair the sectional crossing rails are given an additional support, the plate being made adjustable to a certain extent by tightening the section of the chair.

TRUCK.—John Cornelius, Oakland, Md. In this truck the platform is movable vertically above the bed, and may be raised and lowered by a power mechanism so constructed as to enable the depot hands to readily operate it. It is especially adapted for use where it may be desired to load heavy freight from one level to a higher one, as from the level of a platform to that of a car door.

Electrical.

FOOT WARMER.—William E. Ulmer, Hoquiam, Washington. In a suitable box are holders for a number of electric lamps, the box having a slotted or apertured cover, and the heat generated being controlled by turning the lamps on or off. This foot warmer is adapted for use where a small area is to be heated, or where a small amount of heat is required locally, there being under each lamp a concave reflector to project the heat all in one direction.

MAGNETIC TOOL.—Jacob F. Standiford, Muscogee, Indian Territory. Combined with magnets and a casing is a vibrating armature extending across the upper ends of the magnets, the armature having a vertical aperture in line with the core of one magnet, through which loosely extends a tool holder, a spring throwing the armature away from the magnets, while the armature also raises the tool holder against the action of a spring. The improvement includes a battery circuit and means for closing the circuit when the armature lever rises, the tension of the actuating springs being regulated by set screws to afford perfect control of the stroke of the tool.

HANGER FOR LAMPS.—Samuel O. Larkins, Blair, Neb. This is a simple device for supporting incandescent lamps at any desired height, and which may be adjusted to support lamps and fixtures of different weights. The operative parts of this hanger are inclosed in a metal casing, having a lower tubular neck through which the lamp cord passes, the torsion of a spring counterbalancing the lamp and its shade. When the lamp is lifted the spring winds the cord, and the lamp is lowered by pulling it down against the resistance of the spring, which is thus wound. Should there be a short circuit in any of the parts, a cut-out wire will fuse and prevent injury to the hanger.

Mechanical.

OIL CUP.—John U. Zurlinden, Billings, Montana. This invention relates particularly to automatic cut-off lubricators, where the oil is fed by a reciprocating plunger, and provides a device particularly adapted for attachment to locomotive crank pins, or to any revoluble shaft. The quantity of lubricant fed can be readily regulated without removing the device, and an auxiliary feeding device is provided whereby an additional quantity of oil can be quickly introduced and fed as desired. The oil cup has a passage in its shank in which is arranged a reversible reciprocating plunger rod, reduced for one-half its length, while valve disks are arranged upon the rod.

LUBRICATOR.—This is a further invention of the same inventor, for an improvement upon the lubricator previously described, and provides improved means for the adjustment of the plunger, and other novel features, to make a simpler and more efficient lubricator.

PAPER FEEDING ATTACHMENT.—Nicholas Lux, Topeka, Kansas. This is an attachment for automatically and accurately feeding paper to printing presses, ruling machines, etc. It is of simple and durable construction, and consists of a frame provided with legs, cams revolving on the frame and adapted to lift the legs off the paper, at the same time pushing the top sheet forward. The frame, with entire feeding attachment, is readily swung upward out of the way when it is desired to feed by hand.

Miscellaneous.

MOISTENING FURNACE AIR.—Joseph A. Jeffery, Shell Lake, Wis. This invention provides an apparatus for moistening the air heated in a hot air furnace for delivery to the rooms of a building, the evaporation to be controlled by the temperature and humidity of the air entering the flues rather than by the heat of the fire pot. Evaporating pans are arranged in the furnace and connected with an outside water tank by means of a valve-controlled pipe whereby the water supply is regulated, the evaporating surface of the pans being increased or decreased as desired.

SUGAR CANE MILL ATTACHMENT.—John C. Riley, New Orleans, La. This invention provides a strainer and elevator for the cane juice, as it comes from the mill, preparatory to being pumped to pans or other vessels for further treatment, the trash or bagasse running with the juice being carried off previous to straining the juice. A casing is provided having a perforated plate upon which the juice is run, and scrapers are made to move over the perforated plate to scrape off any trash and bagasse deposited there by the juice.

WHEEL.—George P. Fisher, Bucyrus, Ohio. This improvement is especially designed for bicycle wheels, the wheel having a rim cushion composed of a series of hollow balls on which is fitted a tube with an internal circumferential groove or channel. If the tube be punctured in use, the balls will carry the rider on and prevent the collapse of the tire, or if one or more balls should be punctured or broken, the tube will sustain the rider.

MECHANICAL INDEX.—Andrew E. Carlson, Wallace, Idaho. This is designed to be more convenient for reference than the ordinary book form of index. It consists of a stand with a central vertical shaft, and a series of radially arranged wings attached to a cylindrical center and revolving on the vertical shaft, the wings being formed of metal frames with detachable cards bearing names slipped therein, and protected by a glass or mica facing. The index is designed to be made up in ornamental style, and to be set up on a desk or table.

INCANDESCENT GAS LAMP.—Joel G. Jackson, Minneapolis, Minn., and Addison L. Daniels, Marion, Iowa. This lamp is adapted to burn any of the gases from petroleum, giving a brilliant light without making any odor. The flow of gas is supplied centrally and with a uniform current, just the exact quantity of air required being admitted to the air mixer, and the mingling being made thorough, while the burner is so constructed that a current of air is admitted to the middle of the flame, and the refractory mantle and its holder are so arranged that the mantle will not be unduly heated. The lamp has other novel parts, all provided with a view of obtaining complete combustion and rendering the light extremely luminous without odor.

BICYCLE GEAR.—Emil Gundelach, New York City. This is a differential gear especially designed for safety bicycles, whereby it will be easy to run the machine at a high speed on a good and level road, the gear being changed for a low speed for hill climbing. A countershaft is geared to the crankshaft, and a gear is laterally adjustable on the counter shaft, a third shaft geared with one of the bicycle wheels being adjustable toward and from the countershaft, and a cone or stepped gear being mounted on the third shaft. The change from one gear to the other is readily effected.

TROUSERS STRETCHER AND SHAPER.—Henry E. Featherstone, West New Brighton, N. Y. This invention provides an improvement in stretchers, consisting of an attachment whereby the trousers stretched will be given a curved line at the seam, representing the proper shaping of the trousers. The attachment is applicable to any form of trousers stretcher.

THILL COUPLING.—Andrew Hummer, Maria Stein, Ohio. This is a very cheap and simple device which may be applied to any vehicle, enabling the thills or pole to be quickly and securely attached to the axle or as readily detached without the use of any tools. Its construction is such that the thills or pole may be easily turned up and fastened out of the way. It is adapted to prevent all rattling, and may be adjusted to take up wear as it occurs.

BUCKLE.—George M. Aylsworth, Collingwood, Canada. This is an improvement in buckles used to adjustably connect parts of harness for draught animals, being convenient to adjust and simple and cheap in construction. This buckle obviates the need for a keeper loop on the strap to secure the end of the strap from flapping, and the buckle is very light, strong, and neat in appearance.

BRIDLE BIT.—Robert Sears and Lucien B. Lindsey, Spokane, Washington. This bit has end loops to receive the rein rings, a chin strap extending beneath and having a central pad to fit against the chin, the ends of the strap being adapted for attachment to a check rein, and other novel features. It is a simple and strong bit, readily applied to an ordinary driving bridle and to the mouth of a horse, preventing too great slipping of the main bit, and acting as a rest for the chin of the horse, so he can be checked up without discomfort and without injury to his mouth.

ICE CREEPER.—James F. Comfort, Kendall Creek, Pa. This invention provides a simple form of sandal adapted for use in coasting or walking upon frozen snow or ice. It consists of a toe piece and heel piece connected by an adjustable shank, the device being easily fitted to any ordinary sized foot, and thoroughly protecting the usual footwear, while enabling the wearer to walk easily over slippery and frozen places.

SOLE OR HEEL PLATE.—George J. Davison, Richmond, Va. This is a plate which is readily attachable to any portion of the sole or heel of a shoe, and instead of being thick and clumsy, as such plates usually are, it is light, being formed of thin tempered steel, and attached by barbs forming part of the plate, instead of by nails and screws. The plate has beveled edges and extensions, and the prongs are made to enter the sole at an angle, so that the plates do not interfere with the elasticity or spring of the sole.

COOKING AND SMOKING APPARATUS.—John S. and Charles E. Baker, Newberg, Oregon. This is a simple apparatus to facilitate the preparing and curing of meat in butcher shops, etc., requiring but a small amount of fuel to do both the cooking and smoking. From the fire box the flue leads into a casing which forms a smoke house, and provided with hooks to support the meat, but a damper is provided by which the smoke may be passed to the chimney without passing through the casing. A kettle for cooking meats is arranged over the fire box, a pipe conducting the odors from the kettle to the chimney flue, so that no odors or gases from any of the parts escape into the room where the apparatus is located.

COOKING UTENSIL.—Tomas J. Clement, New Orleans, La. This device comprises a flat body portion provided with a handle, and with detachable fingers depending from its lower side, the fingers being adapted to be dipped in dough or batter, and then quickly held in hot grease for cooking. The fingers may be readily removed, and others of different forms substituted, giving any desired shape, and the articles cooked, such as doughnuts, crullers, waffles, etc., may be quickly and easily handled, or, if desired, they can be easily filled with jelly, lemon, cream, etc.

DRIER AND CARBONIZER.—Michael J. Spencer, Lawrence, Mass. In this machine for drying and carbonizing fibrous materials at a comparatively low temperature, the material treated is carried up within a casing by a series of aprons, a fan being connected with a pipe leading from the top of the casing, and the process being continuous at the will of the operator. The machine is different from any other for like purposes.

ATTACHMENT FOR BEDS.—Arie C. Wierenga, Zeeland, Mich. This is a device to prevent children from falling out of bed, and may be readily moved out of the way or fixed up in position to enable an ordinary bedstead to do service as a crib. It is made with angular hangers having a pivoted and sliding connection with the slats, a frame being so secured to the hangers that it may be held by them in an upright position at the bedside or in a horizontal position under the bed.

DESIGN FOR A CARPET.—William M. Daintrey, New York City. This design embraces a body and a border, the body consisting of scroll-shaped stems ornamented with leaf forms on a ground containing fragmentary sprays, while the border has a series of figures in connected series, with scroll-shaped stems ornamented with leaf and branch forms, and festoon figures simulating roses.

NEW BOOKS AND PUBLICATIONS.

RESULTS OF DOUBLE STAR MEASURES MADE AT SYDNEY OBSERVATORY. Under the direction of H. C. Russell, B. A., F.R.A.S., etc., government astronomer. Sydney: Printed by Turner & Henderson. 1891. Pp. 22.

A numerous list of double star measures as taken at the Sydney Observatory will be welcomed by astronomers, as giving them contributions to the astronomy of the Southern Hemisphere. The author has also forwarded us several of his pamphlets on scientific subjects, forming a reproduction of papers as read before the Royal Society of New South Wales during 1891.

DUTY AND CAPACITY TESTS OF WORTHINGTON HIGH DUTY PUMPING ENGINES ON WATER WORKS AND PIPE LINE SERVICES. Henry R. Worthington. New York. 1892. Pp. xxxii, 216.

The record of Henry R. Worthington and of his company in the annals of American invention is so meritorious that the present description of the Worthington engines, as erected throughout this country, and of their returns, is a legitimate tribute to technical literature. The book is fully illustrated and embodies a large amount of interesting matter. We note especially the paper on the great pipe lines from the oil regions to the seaboard, which is of popular as well as of technical interest.

BROWN'S BUSINESS CORRESPONDENCE AND MANUAL OF DICTATION. By William H. Brown. New York: Excelsior Publishing House. Pp. xvi, 350. Price $1.

This work is made up of a number of sections of matter useful to correspondents. It includes advice to student of short hand and of type writing, and remarks on correct spelling, punctuation, abbreviations, etc. One chapter is devoted to a collection of quotations from different languages. Other chapters contain allied matter. Another part of the book is devoted to forms for every kind of business letter; another to law forms of great variety. Finally a number of literary selections are given, together with a "spelling list" of words which are supposed to be difficult to spell.

☞ Any of the above books may be purchased through this office. Send for new book catalogue just published. MUNN & Co., 361 Broadway, New York.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(4713) C. C. says: Am contemplating a cistern on a hill half a mile distant from house, to have 2½ inch pipe to house. Amount of fall 73 feet, object to furnish water for house use and fire protection. What will be probable height stream can be thrown through 1 inch hose with ¼ inch nozzle? Can I throw same size stream, using 1 inch pipe for main? What will be the pressure at house? A. You can throw a ¼ inch stream 38 feet high from a 2½ inch main with stated head. A 1 inch main would be of no value as a fire protection, about 10 feet in height only. For household purposes the 1 inch pipe would flow in all stories, but the friction will give no force to a jet of any value, but will deliver about 7 gallons per minute with an open pipe. When the pipe in either case is closed, the pressure will be 31¼ pounds per square inch.

(4714) A. J. V. asks: Is it possible to attain a greater speed with an ice yacht than the prevailing wind? If so, under what circumstances, and what is the best record? A. A first-class ice boat, the ice in fine condition, the wind from the right quarter, will sail much faster than the wind. A wind of twenty miles velocity per hour will drive the boat fifty or sixty miles per hour. The best record we call to mind for an ice boat is 70 miles per hour.

(4715) Gas Producer says: With steam jet discharging fifteen cubic feet of steam, at pressure of 25 pounds per square inch per hour, what should be dimensions and form of a cone to induce blast of air under grates of gas producer, or mixture of air and steam of the proportions of twenty of air to one of steam by weight? With temperature of air at 60° Fah., what should be temperature of this mixed blast, and what pressure, in inches of water, should it develop? A. Steam issues from a finely tapered nozzle at 800 feet per second at 25 pounds pressure and expands to 700 volumes of mixed steam and air from the area of the nozzle. For the quantity of steam, 15 cubic feet per hour, you will need a taper nozzle ⅛ inch diameter, and for its best work and for 300 cubic feet of air per hour, requires a 6 inch tube 30 inches long, delivering the mixed air and steam at a velocity of 6 feet per second and a water pressure of ⅛ of an inch.

(4716) A. J. B. asks (1) the best way to temper horse shoes and bars for permanent magnets, and if with water to what color? A. Temper to a straw color. 2. Is there any rule (and if so, what) to determine the number of ampere turns necessary to produce a given number of magnetic lines of force in a core of laminated Russian iron or cast iron? A. The rules are rather long to be given here, and should be illustrated by examples. You will find them treated in Sloane's "Arithmetic of Electricity," $1, and also in Thomson's "Electro-Magnet and Electro-Magnetic Mechanism," $6. Either book we can supply by mail. 3. Also the best way of magnetizing permanent steel magnets? A. Simply hold one end against a strong dynamo pole. There are various other ways. You may surround it with a coil of insulated wire or of wire whose convolutions do not touch, and pass a strong current through the coil.

(4717) L. S. S. says: If a train goes 5,000 feet per minute, and another train is behind it, following at the same rate of speed, they are 50 yards apart, the last train has a cannon; when fired will travel the same speed as the train (the cannon ball, of course); will that cannon ball get away from the last train, or in other words, if a man stood on the rear end of first train, could the cannon ball catch the man if aimed at him? A. Yes.

(4718) J. L. P. writes: I have a ring armature about 2¼ inches in diameter by 2 inches across the face. It is wound with 12 coils of No. 19 magnet wire, each containing about 11 feet or a little more, about 135 feet in all. Do you think it could be used as an armature for a small dynamo? I have a set of field castings to fit, and want to use it for something. A. Your armature will answer for a small dynamo or motor. You cannot, however, expect very much from it. Consult SUPPLEMENT, No. 641, for information as to the construction of a small motor.

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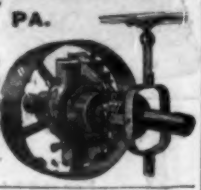

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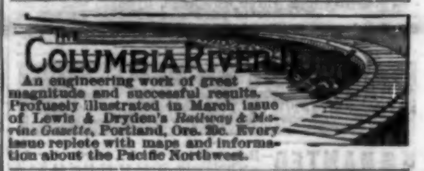

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